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Analysis of faunal remains from the Excavations at Dholavira (District Kutch, Gujarat)

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Chapter 1

1.1 Introduction

It is a story material to recount that Charles Masson (1843, vol. I: 453-54) was the first to notice, way back in 1829, the ruins of a castle and buildings at Harappa, that Alexander Burnes (1835, vol. I: 117-18) was the next to visit it in 1831, and that Alexander Cunningham (ASR: 1872-73) explored and probed the site three times since 1853 and collected (Harappan) material that was unrelated to any known phase of the Indian culture, but the fact of exceeding import is Marshall's permitting Daya Ram Sahni in 1921 to excavate what providentially revealed the presence of a highly advanced urban civilization of an uncertain (pre-Mauryan) date. A year later (1922), Rakhal Das Banerji chanced to find an identical material at Mohenjo-daro while excavating a (so-called) Buddhist *stupa* atop the western (citadel) mound. The finds from both the sites excited Marshall to throw the "First light on the long forgotten civilization" through the *Illustrated London News*, a reputed weekly, which published it in its issue of 20 September, 1924. It turned out to be a turning point in Indian history. In the following issues of the weekly there appeared in sequel two learned articles respectively by A.H. Sayce (27 Sept.: 566) and C.J. Gadd & Sidney Smith (4 Oct.: 614-16), which eventually convinced Marshall that the new-found civilization was "closely connected and roughly contemporary with the Sumerian antiquities of Mesopotamia dating from the 3rd or 4th millennium before Christ", obviously in accordance with the chronological considerations of the then prevailing for the Mesopotamian history (although, now the time-bracket has been revised to circa 2600-1900 BCE). With one stroke thus the antiquity of Indian culture was added up with about fifteen centuries more. This was widely considered as a sensational discovery beset with pragmatic hope for the future. This was how Harappan civilization, widely known as well as Indus civilization (although, of late, some prefer to call it *Sindhu/Indus-Sarasvati)*, came to the light with a bang by the efforts of the Archaeological Survey of India. By the sidelines it may be interesting to know that Marshall first called it Indo-Sumerian civilization, an

appellation which he subsequently dropped, however, in preference to the first one mentioned above.

India had always claimed a hoary past and was proud of having a long continuous literary tradition for millennia. But, the modern historians largely considered it to be a myth for want of archaeological evidence. “India had no Bronze Age;” Vincent A. Smith wrote in 1905, “that is to say, she never passed through a stage of civilization marked by the general employment of bronze, an alloy of copper and tin for manufacture of such implements and weapons……..”. The Indian history then was started in 327 B.C. when Alexander of Macedonia crossed the Hindu Koh and led his army over the river Indus to conquer the north-western India, or at most in the 6th century B.C. when Buddha and Jina were preaching their respective *dhamma*s during the time of the ‘sixteen great states’ in India. It was just 15 years later to the Smith’s statement that the dramatic discovery of a Copper Age culture at Harappa (now in District Sahiwal, Punjab, Pakistan) made by Daya Ram Sahni, and, a year later, at Mohenjo-daro (District Larkana, Sindh, Pakistan) by Rakhal Das Benerji, both of the Archaeological Survey of India, not only pushed back the antiquity of India to the 3rd millennium B.C., but also brought to light a highly advanced urban civilization which was found ranking with contemporary civilizations of Mesopotamia and Egypt. Following the standard practice, the archaeologists christened this anonymous civilization as Indus valley or Indus civilization and alternatively also at Harappa civilization after the type site where it was first discovered. It was indeed a spectacular civilization which is now believed to have flourished from 2600/1900 B.C.

The Harappan civilization, quite spectacular and sensational that it is, is notable for attaining a high degree of sophistication, standardization and utilitarianism in all spheres of life such as settlement planning, monumental buildings, impressive architecture, stamp seals, the script, weights and measures, pottery art, jewellery, implements and many other minor artifacts. Furthermore, it is notable for its phenomenal growth and prosperity, close cultural uniformity, mass production of crafts, complex trade mechanism, maritime trade and intercultural contacts, besides a long life and a vast territory. In all, it indeed

made a remarkable civilization. Its elaborate trade mechanism controlled the process of procurement of raw materials, converting them into finished products and transporting them over long distances by both water and overland routes to domestic as well international markets. Gold, silver, copper, bronze, copper alloyed with tin, and lead, sources of which were most likely lay outside the cultural boundaries were known to the Harappans. So was the case with lapis lazuli, while ivory and marine shells could have been collected from the home areas themselves. All those speak of a system which induced for surplus food production and controlled its efficient distribution to promote and sustain specialized activities by different classes of artisans and craftsmen as well as well by organized trading community. The Harappans had brisk trade relations with Mesopotamia, parts of Iran, central Asia, Oman, islands of Bahrain and Failaka.

Their religion and belief system too does not seem to be naive. Representation of real, syncretic, or mythological animals, humans, anthropozoomorphs, trees, sacred symbols particularly on seals or in figurines of terracotta, faience and bronze, sometimes just engravings on stone, pottery or terracotta objects, all being fine to exquisite specimens of art also speak of an elaborate mythology having a long background. Their burials furnished with offerings indicate their faith in life after death, some mythological scenes legends.

Harappans had a highly stratified society. Citadel in a city or town, which was fortified by massive walls and which occupied a vantage location, was an important division from where administration and rigorous discipline may have been exercised. What was the nature of authority is a moot point, scholars speak of ‘priest kings’ or business tycoons or overlords with provincial potentates effecting through generations vigorous and rigorous political and socio-economic administration. Human remains from the graves evidence for a mixed population in which there were both having long-headed as well as round- headed peoples, although modern anthropologists do not accept such racial divisions. There is at present hardly any evidence as to which type or types represented the ruling elite, business class or commoners. However, it is generally accepted that is was a cosmopolitan and complex society having its roots, in the subcontinent, not elsewhere perhaps.

The Indus people invented a writing system which still remains an enigma due to the absence of either well-defined antecedents or any connection with any of the later scripts of India. Thus, the language (s) and the script have remained a closed book and an undecoded entity respectively. This is why the real identity of the authors of the civilization is still a debatable question.

For long the Indus civilization remained as an isolated phenomenon with no known beginnings or end. Much of the incoherence has since gone due to the last five decades of the concerted efforts of the the archaeologists of India. Pakistan, UK, USA, France and, to some extent, of those from Germany and Italy: an almost continuous sequence of archaeological cultures starting from the early farming communities of the pre-pottery Neolithic period of circa 7000 B.C. down to the beginning of the history of India around 600 B.C. has been obtained. The Harappa culture stands no longer in its majestic isolation. It is now abundantly clear that its birth was a logical culmination of a long cultural process which assimilated and accommodated multifarious elements and influences from a miscellany of preceding cultures which were flourishing in the greater Indus and the upland valleys of Baluchistan and beyond. Forces of rapid integration brought about an overriding unity over a vast area which is calculated by J.M. Kenoyer to 680,000 square kilometers in extent, 'an area twice the size of ancient Egypt or Mesopotamia', yet, there were regional characteristics which later on became dominant when the integration loosened and gave way to transformation which, in turn, degenerated into de-urbanization and assumed different form in different regions. The urban features disappeared. After a long process of evolution in the order, those rural cultures of the late copper age dovetailed or transformed itself into one or another early Iron Age culture which finally merged into, or emerged as, one of the early Historical cultures during the sixth/fifth century before Common Era. As already stated, the Harappan civilization was a logical conclusion of a long cultural process that stared in the $8^{th}/7^{th}$ millennium BCE as revealed at Mehrgarh in the Kachi Plain of Balochistan (Pakistan).

The early village farming communities of Aceramic period at Mehrgarh had started living in well made houses of mud-brick of definite shape and measurements cultivating three varieties of wheat, two varieties of barley,

breeding, sheep, goats and cattle, making tools, including sickles of chert, jewellery of steatite, exotic lapis lazuli, turquoise (from north Afghanistan and Iran/Central Asia respectively) and marine shells (from the Arabian Sea), household vessels and equipments of stone, making basket and mats of vegetal materials and burying the dead along with personal ornaments on body, occasionally with animal food, body being laid in foetal position in specially made graves. Besides, there were few clay figurines of standing and sitting types. Polished stone celts occurred only towards the last two phase of occupation. A string of (native) copper beads in a cotton thread was of high importance. During the following Ceramic period the way of life continued with the significant introduction of crude hand-made pottery, which overtime increased in quantity and quality. However, appearance of a new variety of barley as well as barley wheat was significant, and equally important was the find of charred cotton seeds. The following period III: was marked by the introduction of copper technology, potter's wheel and intensification of animal domestication. The following four periods, viz. period IV through VII exhibited a dramatic change in a continuously evolving chalcolithic way of life. The chrono-cultural framework is given below in tabulated form: The later periods, viz. from period IV to VII made a significant departure in which the earlier villages changed into small compact villages with different architectural norms in which houses were made of molded mud-brick and planned differently as if for a nuclear family. This became the norm all through during the following millennia India. In period IV, the Kechi Beg ware and the Togau B & C were potteries came to the fore. This period is also marked by phenomenal increase in settlements at Mehrgarh as well as by outward movement of the peoples towards the riparian plains of the Indus and its western tributaries and also the Sarasvati (Ghaggar-Hakra). This period also evidenced an irrigation canal and grape cultivation. Period V, among several other things, was noted for the Kechi Beg polychrome, evolved Togau ware, Fiaz Muhammad Grey ware, Quetta wet ware jars and the canister pots, ancestral to the Nal pottery. Period VI was distinguished by the black on grey ware, Quetta ware, Nal polychrome and red ware with painted *Pipal* leaves. Compartmented stamp seals were also present. This period showed parallels with Damb Sadaat II, Mundigak III, Shahr-i-Sokhta II, Rahman Dheri I, Amri II A. Period VII was

represented by black on grey ware, late Quetta style and marked with mass production of female and male figurines, a monumental platform. Its upper levels yielded so-called Zhob figurines and a few Kot Dijian style sherds. Its cultural parallels are seen in Damb Sadaat III, monochrome geometric style of Nal, Mundigak IV, Shah-i-Sokhta II, Kot Diji, Amri IIB. With this early cultural sequence comes to end but the thread was picked up by Nausharo where Mehrgarh VII is more or less period I. the later, like the former, was subdivided into three phases known as A, B, and C. at Nausharo, IC was followed by ID which was deemed to be the early phase of the Kull culture. This phase was gutted in a fire and was followed by three phases of the Harappan civilization, called there as periods II, III and IV. Now, the thread was picked up by Mehrgarh where it was period VIII.

I.	Early Farming Stage I : Aceramic	c. 7500-5500 BC	Village Economy I
II.	Early Farming Stage II : Ceramic	c. 5500-4500 BCE	Village Economy I
III.	Start of Copper Age	c. 4500-3800 BCE	Village Economy II
IV.	Compact village Economy & expansion into riparian plains	c. 3800-3200 BCE	Village Economy II
V	Beginnings of proto-urban :	c. 3200-2600 BCE	Town Economy
VI.	Harappan urbanism :	c. 2600-1900 BCE	Metropolitan Economy
VII.	Break-up of urbanism	c.1900-1200 BCE	Back to Village Economy
VIII.	Beginning of Iron Age	c. 1200-800/700 BCE	

Thus a frame work of reference is available now, and the same, following Shaffer (1992: 441-64), Kenyoer (1998: 24, 25, 26) calls the whole cultural system as the Indus Valley Tradition, divisible into five eras, namely Early Food Producing Era (Neolithisc/Chalcolithic – c. 6500 to 5000 BCE), Integration, Era (Harappan: 2600 to 1900 BCE) and Localization Era (Late Harappan: 1900-1300 BCE). Possehl (2002:29), however, calls it the Indus Age Tradition, divided into seven stages, viz. I: Beginings of Village Farming Communities and Pastoral Camps (Killi Ghul Mohammad 7000-5000,Burj, Basket-Marked stage 500-4300 BCE), II: Developed Village Farming Communities and Pastoral Societies (

Togau 4300-3800, Kechi Beg/Hakra wares 3800-3200 BCE), III: Early Harappan: 3200-2600 BCE (Amri-Nal, Kot Diji, Sohti-Siswal, Damb Sadaat phases), IV: The Early Harappan-Mature Harappan transition (2500-1900 BCE (Sindhi, Kulli, Sorath, Panjab, Eastern phases), VI: Post-urban Harappan (Jhukar 1900-1600, Lustrous Red Ware 1600-1300; Late Harappan Phase in Haryana and Western Uttar Pradesh 1900-1300, Early Pirak 1800-1000, Swat Valley 1650-1300, Late-Harappa-Painted Grey Ware Overlap 1300-1000, Early Gandhara Grave Culture 1700-1000 BCE) and VII: Early Iron Age of Northern India and Pakistan[1] .

A deeper study of gradually emerging elements at different points of time makes it abundantly clear that the birth of the Harappan civilization was a natural corollary of a long-drawn culture process that started in the 8th millennium BCE. It naturally assimilated and accommodated in it multifarious elements and influences from a miscellany of the preceding cultures that were flourishing in the greater Indus plains and the upland valleys of Balochistan. Yet it is not very clear as to how the forces of rapid integration brought about an overriding unity over an extensive territory, that too within a short time period. Many of the classical Harappan elements had, in fact started appearing, albeit in less developed from, right from the beginning of the sedentary way of life. On its march over time many new elements were created by the Harappans themselves

Excavations at Harappa and Mohenjo-daro continued adding more and more to the Harappan civilization. Harappa, among many other things, yielded a large granary and thrashing floors at mound F, then lying beside the Ravi, in addition to a post-Harappan (Cemetery-H) cultural phase. Later, fresh excavations at Harappa by R.E.M. Wheeler in forties conclusively attested the existence of a formidable fortification with bastions and a gate, and also a Harappan (R-37) cemetery. Mohenjo-daro provided abundant insight into the urban planning highlighted by a well-defined system of streets, residential sectors, blocks and individual houses, largely furnished with assured water supply from private and public wells, and also with bathing platforms, toilets and public sanitary drainage in both the citadel and the lower town. The citadel in particular showed some large buildings, including one with the famous Great Bath and the other was a pillared hall. It may not be out of mark to record the find

of a large granary, Two and a half decades later, Wheeler revealed a fortification that may have enwalled the citadel mound, and it was found furnished with a bastion and a gate. In addition, he unearthed a large building which is called granary.

In the meantime, extensive explorations in Sind and Baluchistan added many more protohistoric sites and two of them, Chanhu-daro and Amri (both in Sind), were chosen for excavation. While both evidenced post-Harappan cultures above the mature Harappan, the latter provided a substantial deposit related to many phases of an antecedent culture (Amrian).

In the wake of the partition of India in 1947 all the important Harappan sites were lost to Pakistan. The concerted efforts of the Indian archaeologists made good the loss by bringing to light a number of sites. Amalananda Ghosh, (1952: 37-42), who was to be appointed soon as Director General of the Archaeological Survey of India, took the lead and systematically surveyed the valleys of the Ghaggar (ancient Sarasvati) and the Chautang (Old Drishadvati) in north Rajasthan. He discovered one hundred sites of which twenty five were mature Harappan. One of them was Kalibangan, (which was subsequently excavated on a large scale in the years 1960-69). By all means, it was a great achievement which emphatically extended the Harappan territory towards east as foretold by Marshall. In Gujarat, survey was largely initiated by S.R. Rao, who was followed by a large number of archaeologists belonging to various agencies, such as Possehl, V.H Sonawane, (Sonawane 1994:129-39), K.T.M. Hegde and his team, J.P. Joshi in Kachchh, archaeologist of the Gujarat Department of Archaeology as well as the Archaeological Survey of India. In Haryana, the thread left by Ghosh was picked up by Suraj Bhan, to him the credit goes for reporting a large number of pre-urban, urban and post-urban settlements in Haryana, which included Rakhigarhi, Banawali (Wananwali, as then reported), Mitathal and Farmana which have been subsequently excavated. His work was carried forward, albeit after a period of lull, by archaeologists of State Department of Archaeology (C.P. Singh and D.S. Dupia), of universities of Kurukshetra (Suraj Bhan, U.V. Singh, Silak Ram, Amar Singh, Manmohan Kumar) and Rohtak (Silak Ram, Amar Singh, Manmohan Kumar, Vivek Dangi) the Indo-French

archaeological project in Haryana and Rajasthan (Henri Paul Francfort being the leader of the French team this author and A.K. Sinha, being that of the Indian team alternately) and now joined by those of B.H.U., Varanasi (R.N. Singh, C.A. Petrie and others) together with British archaeologist. In Panjab, the work was carried over by Bisht, G.B. Sharma, K.N. Dikshit, Joshi and some officials of both the concerned state department and ASI, although the entire region yet remains to be investigated. Likewise useful work was done in the Ganga-Yamuna Doab in U.P. and adjoining areas of north-eastern Rajasthan by K.N. Dikshit, Shankar Nath, Maragbhandu and B.S. Negi., admittedly though no site of the classical Harappan phase remained non-existent in the two last-mentioned areas where at best just three sites like Hulas, Alamgirpur and Bahadarabad, which can only be placed that post-urban phase which immediately followed the urban one showed that towards its fag-end the Harappans started penetrating into the upper Doab, rather hesitantly.

Very useful work of survey has also been conducted in Pakistan, too, Mughal (1997) explored in the Cholistan desert, along the dry bed of the Hakra (the Ghaggar), and brought to light 363 pre-urban, urban and post-urban sites which he related to the Indus tradition. Besides, field work was done in the Punjab, Sindh, Baluchistan and Wazristan by several archaeologists of Pakistan, Europe and United States of America. In this regard, mention may be made of the survey done by Walter.A. Fairservis, Jr., Beatrice the Cardi, Jarrige, Louis Flam, Farzand.A. Durrani, M.Roland Besenval, P.Sanlavilla, Rita Wright, Nilofershaikh, Qasid H. Mallah and some others.

The discovery, followed by systematic excavation of a Harappan site of Shortughai in the Kokcha-Oxus valley, across the Hind Koh, in north Afghanistan, by Henry-Paul Francfort, was of great significance because of its being far away from the cultural boundaries of the Harappan civilization and also being close to the lapis lazuli mines of Badakhshan.

More than four dozen sites have been excavated in the subcontinent and each site contributed much complementary and supplementary information to the Harappan series.

1.1.1 Harappa

The fresh excavation was under taken conducted under Dales, Meadow and Kenoyer (Meadow 1991; Kenoyer 2011: 1-18) demonstrating that even the mounds E and ET were fortified ones, with a common wall between the two, shared by both. Curiously, these newly found defensive walls are unusually curvilinear in formation, not conforming to the Indus standard of town planning. It may be recall that the Harappans also made a bold departure from the norm at Banawali, where the later layout was however, conditioned by the pre-existing defences of the antecedent period. Besides, a five/four cultural sequence that came to light was another significant contribution. The freshly established sequence comprises: Period 1 A and 1 B- Ravi (Hakra) phase (c.>3700-2800); Period 2- Kot Diji Phase (c. 28000-2600); Period 3 A- Phase (c. 2600-2450); Period 3 B- Phase (c. 2450-2200); Period 3 C- Phase (c. 2200-1900); Period 4 Harappan/ Late Harappan Transitional (c. 1900-1800); Period 5- Late Harappan Phase (Cemetery H) (c.1800(?)-1700).

The Ravi phase is the same which is called the Hakra culture by Mughal in Cholistan. So far as its lower date, i.e. is c. 3700 BCE is concerned it seems to be overestimated. It may be recall that the excavators earlier dated it to 3300 BCE. Furthermore, the Harappan types of seals and some other material have started occurring in the Kot Diji phase. It is also significant that Harappa has revealed a transitional phase between the mature Harappan and the Cemetery H periods. Fresh excavation in Cemetery R-37 has brought to light not only usual extended inhumation, but also symbolic graves with pottery offerings, only. More examples of keeping body in wooden coffins were also found Much information about anthropometric details, biological adaptation and palaeopathological conditions have also been obtained. Hemphill et al.(1991:137-82).

1.1.2 Kot Diji

Significant excavation, conducted between 1955 and 1957 by F.A. Khan (1965:11-85; 15-24), yielding an enormous occupational deposit of about 10.35 that was divided into two periods, each sharing almost half the accumulation. Period I, which has chronological and stratigraphical priority over the Harappan

occupation has provided a fortified settlement, and the structures were constructed right against the defensive wall. The period was distinguished by its distinct pottery of pinkish red ware which is named after the type site so is the culture it represented. The entire settlement suffered at least two general conflagrations, the last being followed by the appearance of the mature Harappans who, according to the excavator, raised a settlement in two parts viz., the citadel on the higher ground caused by the antecedent deposit and the general habitation in the lower area.

The material of Period I was re-studied by Mughal (1970) who observed slow and steady emergence of some of the standard Harappan items from the middle level upwards and, therefore, maintained the existence of an earlier formative stage of the Harappan culture. He gave it the name Early Harappan-a term which has since got a wider currency among archaeologists working in South Asia. In conclusion, fresh survey has shown that the Kot Dijian covered an extensive area of distribution of which the type-site lies at the southern limit; In the north, it has been found spreading up to the Taxila valley where Sarai Khola (Halim, 1972a: 23-89;1972b: 1-112) is an important site.

1.1.3 Amri

It may be recalled that Amri lying on a high spur on the right bank of the Indus in Sindh (Pakistan), has shown the presence of a pre-Harappan culture for which it is now become the type-site for a different regional culture which extends up to Sindh Kohistan , although two of its sites have since been found on the other side of the river as well.

The site was re-excavated in 1964 by J.M. Casal (1964, 1978) who brought to light a five-fold sequence of cultures. The first period was subdivided into four phases, namely periods IA to ID, followed by two phases of period II, i.e. IIA and IIB. In ID, a few sherds, and in IIA and IIB, a few more sherds of Harappan affiliation were noticed in an otherwise continuously emerging non-Harappan cultural milieu which was given the name Amrian. In period IIIA, the full-blooded Harappan culture, with its distinctive pottery, architecture and other artifacts, makes its appearance. Period IIIC was equivalent to the upper level of Mohenjo-

daro where signs of decline are present. Period IV, belonging to the Jhukar period, a post urban chalcolithic culture, was found mixed up with the still later relics of the Jhangar culture. However, the pottery of Jhukar has become well-known as representing a culture that is subsequent to the mature Harappan culture at Chanhu-daro. Subsequent excavations conducted at the type-site of Jhukar have shown that the typical Jhukar pottery had started appearing in the late phase of the mature Harappan culture and became pre-eminent after the urban phase was over. Significantly, two Amrian sites, Tharro (Tharri Cujo) and Kohtras Buthi have shown up evidence of being fortified settlements.

1.1.4 Lothal

Lothal (Village Saragwala, District Ahamadabad Gujarat, India) was discovered and excavated by S.R. Rao from 1955 to 1962. The work was started simultaneous with that at Kot Diji. He divided the cultural deposit into two periods, viz. Period A Mature Harappan , sub-divided into four phases called I to IV; Period B, i.e. Late Harappan was called phase V with two sub-phases- IV A and IV B. The Harappan settlement here is a fortified one, additionally accommodating within it a high mud-brick platform supporting structures. The excavator calls it acropolis. As is well known, Lothal is famous for its dock, along with its appurtenant wharf, nearby warehouse, a hostel, probably for the visiting traders, besides being another centre for making gemstone beads. The site has also given a typical Persian Gulf seal, pointing to external trade with the Gulf region. Locationally, it was a distant frontier town which served as a port, primarily.

It has also yielded a cemetery, in the north-west part, outside the defences. There have been exposed in all sixteen burials, eleven of which belong to the mature mature Harappan period and the remaining to the post-urban phase. Most significantly, there are at least three joint burials, each with two bodies, of their own kind in the Harappan context. Anthropological study has confirmed that in one of them two male adults are buried together in a brick-lined grave, in the second both are adults, sex not known, while one is clearly a male

and the other one is suspected to as such. In case of the third joint burial there is one male adult whereas the other one evades precise sex-determination.

1.1.5 Mohenjo-daro

Wheeler exposed a granary at the citadel mound and cut across the defences where he tried to fathom the levels lying in the water table. He could succeed only partially to the extent of retrieving about 3.25 m of the waterlogged levels. However, the results were immensely rewarding in that his excavation revealed different phases of reconstruction of the fortification wall in association with pottery and artifacts. Many decades later, his assistant (Alcock 1986:493-551), briefly discussed and illustrated the pottery, as already been mention. It is most significant that this early pottery of Mohenjo-daro, at least typologically and in colour, corresponds fairly well with early pottery of Stages I to III of Dholavira. Within the short time that Alcock had, he could draw the shapes without only and did not state about others details of slip and painting on them.

The site was re-excavated by Dales (et. Al. 1986) and Kenoyer who produced a volume on pottery in great details and made a detailed typological classification, including standardizing different parts of pottery shapes.

1.1.6 Rehman Dheri

Rehman Dheri, excavation at Rehman Dheri by A. Durrani (1982:191-207;1988), in the Gomal plain (Pakistan), has revealed a different manifestation of pre-Harappan culture which is closer to that of north Baluchistan. Some Kot Diji ceramics appear in the upper levels while the Harappan material is absent, although the latter is present in a neighbouring site called Hisham Dheri lying 400 yds. away towards the north.

In addition, Rehman Dheri provides evidence of a fortification which should have run on all four sides of the settlement with a formal planning of streets lined with house blocks as strongly suggested by the contours seen in an excellent aerial photograph. In my view, the settlement came to an end before the

appearance of the Harappans who preferred to lay down their settlement some distance away. A possibility cannot be ruled out that the latter were responsible in some ways for the desertion of the site of Rehman Dheri. The radiocarbon dates later of which fall in time period of Harappa are not tenable at all. The entire sequence should fall before 2500 BCE.

1.1.7 Kalibangan

Kalibangan lies on the left bank of the seasonal channel of the Ghaggar, now in District Hanumangarh. The site, excavated for nine field seasons from 1961-1969 by Lal (1975:65-67) and B.K. Thapar (1975:19-32), has revealed a two-fold cultural sequence, viz. Period I, Sothi culture (pre-Harappan/Early Harappan,) and Period II, mature Harappan. Kalibangan is important for providing a fairly complete conformation of the Sothi period, as well as, for the first time, a model of a classical Indus town planning, and also for yielding a pre-Harappan cultural milieu within a fortified settlement, with an outlying ploughed field (the earliest found so far). The antecedent culture was designated after Sothi, a site in the Chantang (ancient Drishadvati), where it was first discovered by A. Ghosh.

The pre-Harappan settlement was a fortified one, designed in the form of a parallelogram, measuring 240 to 250 m from north to south and 170 m from east to west. In the succeeding period, the Harappans superimposed their citadel upon the antecedent settlement, while a part of the latter in the east was left out as an open area beyond which, to the east was laid out the lower town. Interestingly, the citadel has more or less two equal parts, segregated from each other by a massive fortification. Of course, the entire citadel is circumvallated. The southern half was enclosed by especially massive defences. Inside, there were a series of platforms. The lower town was located some distance to the east of the citadel. It was also designed in the form of a parallelogram measuring 240 m from east to west and 360 m from north to south, with an excellent system of streets and housing blocks. In planning, two more divisions or subdivisions which are present at Kalibangan have more or less been overlooked, particularly to south of the citadel, which was investigated in the first year but never discussed, although this lies at par with the southern limit of the lower town. It is not

impossible that it was also fortified. The other sub-division is to the east of the lower town where a number of fireplaces were observed, hence considered to be an area sacred to the fire-cult. Not unlikely, it was an industrial area, instead of being ritualistic in nature.

Period I at Kalibangan, which is now consensually designated as Sothi culture, is marked by six ceramic fabrics called A, B, C, D, E and F. Culturally, the Sothi at Kalibangan cannot be deemed to be an early Harappan in that it had different norms of architecture and ceramics as well as other artifacts, which did not linearly or genetically contribute towards the make-up of the Harappan culture. Unlike the Harappan ones, the Sothi bricks here revealed a ratio of 3:2: 1. The ceramic corpus also stands apart from the succeeding one. In place of long Harappan chert blades, it yields bladelets of chalcedony. Although the excavators believe that a short-lived hiatus separates the two periods, it is more plausible that the Harappans took it by storm, as is fairly indicated by the use of at least three of the walls of the earlier fortification, albeit with due reinforcement, and also in the use of pottery of the earlier period at least up to halfway through the Period II. The subsequent filed work demonstrates that the Sothi culture had a very wide distribution zone comprising north Rajasthan, Panjab and Haryana.

For the first time, Kalibangan (Sharma, 1999) has yielded three types of burials, viz.: (1) inhumation with pottery offerings, (2) grave with pottery offerings only in a rectangular grave, oriented north south and (3) pottery offerings in circular pits. Those without skeletons were interpreted by the excavators as graves made *in absentia* when the body could not be reclaimed as death of the deceased occurred far away from the home, in war or in foreign lands. But now, we know that the Harappans did raise memorials, too.

1.1.8 Banawali

Banawali (Bisht, 1976;--, 1977; 1978; 1982; 1987), now in District Fatehabad, Haryana (India), lies on the dry bed of the Sarasvati, upstream of Kalibangan. The site has revealed a three-fold sequence of Sothi, Harappan and

post-Harappan cultures, designated as Periods IA and IB, I C, II and III respectively. The period I C revealed a proto-Harappan phase. The Sothi settlement was initially (IA) was an open settlement which was subsequently (IB) enclosed by defences making a large oval in outline (which conditioned the unusual planning of the succeeding Harappan settlement, the principal building material was mud-brick made in the ratio of 1: 2: 3: in terms of thickness width and length.

As soon as the proto-Harappns of Period I C arrived on the scene, they erased all the residential structures of the previous period but the defensive walls were re-appropriated, and inside the settlement all the residential houses were constructed afresh in a different pattern of layout following and orientation that was different from that of their predecessors in fact this part was converted into citadel. The settlement was extended on east, north and west within a newly constructed fortification in the form of a irregular trapezium. Inside, a radial system of streets was laid out it was also noted that each house was surrounded by streets and lanes. In the cultural assemblage there appeared new elements such as chert blades, triangular terracotta cakes, 8-shaped terracotta nodules, introduction of brick in the ratio of 1: 2: 4 besides a few sherds of Harappan technology, where as the ceramic of the Sothi period, as found at Kalibangan continued in use.

When the classical Harappans arrived, they adopted the defences with some additions and modifications. They also razed to the ground all the previous residential houses and constructed their own with change in orientation. The preexisting layout was like wise adopted with some modification. Owing to the radial pattern, the streets converged on certain focal points in the lower town area. It is the only site which was furnished with a deep V-shaped moat, surrounding the circumvallation of the town. The citadel, unlike as at Harappa, Mohenjo-daro, Kalibangan and Dholavira, is not a separate entity but is rather accommodated within the town walls. Interestingly, Banawali has yielded a clay model of plough and a fragmentary steatite stele showing a couple of acrobats- a male and female engaged in an exercise. All the classical Harappan elements are present, including some new items of exceeding interest.

The post-Harappan (Banawali-Bara = Mitathal IIB) settlement came into being to the east of the ruins of the Harappan town, most likely after a long gap of time. In contrast to the previous systems, people of this period lived in houses made of mud walls, as was found at Sanghol.

1.1.9 Kech-Makran

The investigation of Sutkagen-dor is important in that it is the westernmost Harappan settlement as usual with defences. Not very far Sutkagen-dor Miri Kalat and Shahi Tump were excavated and large-scale exploration were conducted providing very significant proto-historic cultural sequence, namely Period I Sar-i-Damp culture (end of 5^{th} millennium BCE); Period II Miri culture (1^{st} half of 4^{th} millennium BCE); Period II a Shahi Tump culture (3^{rd} Quar. of 4^{th} millennium BCE to beginning of 3^{rd} millennium BCE); Period III b Dasht culture 1 (2800-2600 BCE); Period III c Dasht culture 2 (2600-2500 BCE); and Period IV Harappan along with local elements (2500-2000 BCE). Interestingly, those periods preceding the Harappan arrival are, by and large, the extension of Iranian cultures.

The area has provided a long cultural succession, the first six of which belong to the protohistoric times, covering a time span from the 5^{th} millennium to 2000 BCE: Besenval, Roland (2005: 1- 9; 2011: 41-164): Period I, the Sar-i-Damb culture (5^{th} millennium BCE); Period II, the Miri culture (1^{st} half of 4^{th} millennium BCE); Period IIIA, christened as the “Shahi Tump Cemetery Culture (mid-4^{th} to early 3^{rd} millennium BCE); Period III b (c.2800-2600 BCE) is Periods III c (2600-2500) and IV, the Indus Civilization (c. 2500-2000 BCE). After the Harappan the entire area was deserted until the appearance of the early Iron Age of the 1^{st} half of 1^{st} millennium BCE.

Period I, which is dated by C^{14} , is present at Miri Qalat, Sar-i Damb and Sahi Tumb. It is represented by a dry stone architecture, a very few sherds and flint tools.

Period II, the best represented at Miri Qalat, was marked by architecture of stone mud-brick, and also by nearly a hundred graves at Shahi Tump, which

were ‘previously incorrectly dated to the 2nd millennium BC’. Each grave housed an individual inhumation, laid in foetal position, smeared with ochre, placed in a ‘material shroud’ or mat-coffin and often provided with much of personal jewellery, and other items, including amulets. Pottery offerings are, however, conspicuous by their absence ; the period is otherwise remarkable for its fine ceramics. The excavator holds that Period II was partly contemporaneous with the Mehrgarh Period III. The grave-goods included sea-shell bangle on right arm, sea-shell necklace (*Engina mendicaria, dentalium)* and copper objects: mirror, axe, spear point, punch, awl, chisel and amulets; stone vessels and pieces of ochre and galena. The pottery mostly consists of high goblets, open pots and bowls with internal decoration. The pottery is highly individualistic and, according to the excavators, has ‘currently no strong comparisons in our collection can be made with chalcolithic cultures of the neighbouring regions’. Nevertheless, radiating or quadripartite decoration on open bowls is widely present in the Iranian plateau and Suusiana at the end of 5th during the 4th millennium BCE.

The funerary practices of the preceding period continued during Period III a, christened as the “Shahi Tump Cemetery Culture (mid-4th to early 3rd millennium BCE), as being represented by sepulchres only. The position and orientation of the body to the accompaniment of miscellaneous offerings continued the same way (crouched position, laid E-W, with the head to the east) as in the preceding culture, but with a notable change, marked by the introduction of fine painted pottery. Barring a solitary example of collective burials, containing four bodies in a grave, all others, are individual interments. Of special interest are the offerings of compartmented “seals” which are found only in female graves. It is most pertinent to state that it is this sepulchral assemblage which was “incorrectly” dated to the 2nd millennium BCE by Sir Aurel Stein on the basis of his hurried excavation. It is however intriguing that no settlement of this period has been found so far in the area. The pottery of this period has shown specific original features, both technically and aesthetically, as can be seen in the Indo-Iranian borderlands. The paste varies from light grey to red-orange in colour. Other object of special interest the stone weights so peculiar to the borderlands,

so are the compartmented copper-lead seals, circular, rectangular or square with traces of thread on the ring at the back- all found mostly in female graves.

Period III b (c.2800-2600 BCE) is determined only by exploration of a large number of settlements, cemeteries, pottery production sites and stray amulets scattered over a wide area. This period has shown a considerable increase in the number of settlements in the entire area. The ceramics include Emir grey ware, incised grey ware, orange-or grey ware with painted and ridged decoration, polychrome grey ware compartment Chrono-culturally, it is, more or less, comparable to the Mehrgarh VII B-C, Nausharo IA, B, C, Nal polychrome ware pottery and Bampur I-IV.

Period III c was found in a one metre thick destruction layer, underlying the Harappan deposit. Ceramically, it is a continuation of the preceding period as represented by flat bottomed dishes, carinated dishes, incised grey ware goblets, thick ridged bowls (Kulli assemblage?), small truncated cones, open bowls and along with in notable innovation of surface decoration with streak -burnished treatment, and a notable absentee is the Emir grey ware.

Period IV in Kech-Makran is also distinguished by the fortified settlements of Sutkagen Dor, Sutka Koh, the fish-processing site of Prahag. Miri Qalat has yielded four m of deposit showing structure of stone and mud-brick, typical bathroom and classical Harappan jars with decoration, a seal showing a unicorn and Indus signs, an ivory comb, all belonging to the early phases of the culture.

1.1.10 Nal

The site, locally called Sohr Damb, lit, ‘burnt mound’, lies in Village Nal after which the ancient site and the culture from there is widely known. For being famous for yielding a beautiful polychrome pottery, along with jewellery items and copper tools, the site has often been excavated indiscriminately or discriminately by many persons. It was always remained in the centre of discussion in respect of its temporal position until it was excavated properly by Ute Franke Vogt (2005: 63-76) along with Asma Ibrahim 2005: 110-112) from 2001 to 2004. It has provided four cultural periods: Period I, Togau phase, Period II, Nal culture,

Period III, Late Quetta/ Sadaat phase, comparable to Nausharo ID or Miri Qalat IIIc and Period IV, Kulli-Harappan (no Harappan material is reported though), all are said to cover a time-span of c 4000/3800 to 2000 BCE.

The discovery of Period I, accounting for 1.65 meters of deposit that precedes the overlying Nal deposit, adds a new cultural dimension to the site. The excavators have reported the find of the Togau C and D ceramics in the graves and those of A and B "in the contexts outside defined burials". Some Nal pottery is said to be appearing in the upper levels of Period I, thus making a link with the following Nal culture. It has also shown up eight graves containing inhumation or fractional burials along with grave goods of pottery, jewellery and occasionally conical weights. At Mehrgarh this situation prevails from Period III through V.

Period II that amounts to a deposit of 2.5 m entirely pertains to the Nal culture. It has so far yielded one rectangular mud-brick chamber, housing a complete skeleton in flexed position, along with four full pots one of which is polychrome.

1.1.11 Balakot

The site was excavated by Dales (1979:241-274) yielding two-fold cultural sequence Period I at Balakot (in Sonmiani Bay 80 km south-east of Las Bela, Pakistan) it represented by 12 m of occupation that shows evidence of the existence of cultural elements of southern Baluchistan, characterized by polychrome Nal pottery style. In the upper levels of the period, this is more or less completely replaced by pottery having affinities with the early Harappan period, especially with those from Amri IC and ID. Period II belongs to the Harappan culture, Remains of monumental structures, all signs of urbanism, in association with Kulli cultural elements, are noticed in this period. The Harappan settlement seems to have followed a formal planning, marked by streets lined with housing blocks. The possibility of a dichotomous settlement with fortifications cannot be ruled out.

1.1.12 Kunal

Kunal (District Fatehaibad, Haryana, India) was excavated by J.S. Khatri and M.Acharya (1995:84-86) in the eighties of the previous century and provided three distinct phases IA, IB and IC. The first was characterized by dwelling-pits and the pottery showing types and bichrome decoration of Kalibangan I, Baror I and Bhirrana I, and I B, by similar dwelling-pits, now lined with mud-brick of no standard size, but its deposit has yielded primitive seals with two perforations and incipient boss at the back, the ultimate phase, i.e. yielded rectangular houses made bricks of Harappan standard. It is this phase which has yielded regalia consisting of two silver crowns, and lots of jewellery of gold, silver and gemstones, etc.

1.1.13 Baror

Baror (District Shri Ganganagar Rajasthan,) that lies close to the India-Pakistan border, is located on the right dry bank of the Ghaggar (Hakra, ancient Sarasvati) was excavated by Urmila Sant and her team from 2003-05, showing a two-fold cultural sequence: Period I, Sothi culture, and Period II Harappa culture.

The initial 1.23 m of deposit yielded a pottery, made on wheel, with irregular striations, of comparatively of thin walls, occasionally decorated with black painting on the rim. The excavators feel that these people were living in wattle and daub huts. The most interesting was the find of six seals, showing only geometric motifs. Some of them have two or one perforations drilled thorough and through in the body, as seen on Mehrgarh specimens. Examples are also there having no hole. There were noticed some flimsy structures of mud-brick measuring 50x20-25x 8-10 cm, thus showing no known standard of ratio. Period II is classical Harappan civilization accounting for a large area and considerable debris. All usual elements of planning, architecture of Harappan civilization are present.

1.1.14 Bhirrana

The excavation at Bhirrana (District Fatehabad of Haryana, India) was excavated by L.S. Rao and his team projecting the following two-fold sequence, each sub-divided into sub-periods, namely Period IA: Hakra Ware, Period IB: Early Harappan, Period IIA: Early Mature and Period IIB: Mature Harappan cultures. The special characteristic of the site is that the first period has given two sets of dates, one going to the fourth and fifth millennia, and second, forth and third millennia BCE. During the Harappan time it was a fortified settlement.

1.1.15 Ropar / Bara / Sanghol-Mitathal

Ropar and Bara, not very far from each other, in the Sutlej Valley, in District Rupnagar, and Sanghol is in District Fatehgarh Sahib (all three in Panjab) and Mitathal in District Bhiwani, Haryana, may be treated in a sequel of chronological order Ropar is already well known to be one of the northernmost Harappan sites (the other being Manda, Akhnoor, Jammu and Kashmir) seems to represent the terminal phase of the classical Harappan period. The original excavator of the latter, Suraj Bhan (1975) who divided deposit into three periods, namely I. (Late pre-Harappan, co-existing with the Harappan), II A Harappan and II B post-urban Harappan. The recent excavation (Kumar et al. 2011; 2012) has shown that first two periods belong to the Harappan and the last phase to the transition. In fact this is more or less is the story of all the four sites where the Bara which is closer to Cemetery H at Harappa was evolving within the Harappa Period and later survived to be a separate cultural entity.

1.1.16 Rakhigarhi

The site lies on the palaeo-channel of ancient Drishdvati which is now represented by Chatang Nala in Haryana and North Rajasthan. It is one of the five largest Harappan city sites in the subcontinent. It has several mounds, two belonging to Pre-/Early Harappan in the mounds of Arada yielding usual architecture and ceramics, the later being belonging to the family of the Sothi with

some perceptible changes. The same cultural meaning and other mound also. The mound which merits to be citadel was found duly fortified with massive walls, typical Indus planning. The site has yielded a huge amount of antiquities, and ceramics. Rakhigarhi has also yielded cemetery lying to the north-north-west of the settlement

There are several other site which have been excavated, like Bagasara, Nageshwar, Pithad, Rojdi, Babarkot, etc. all in Saurashtra (Gujarat), Desalpar, Khirsara, Surkortada, Kotada Bhadli, Kanmer, all in Kachchh (Gujarat), Nagwada, Loteshwar, etc in north Gujarat, Dhaimabad (Maharashtra) and Karanpura (Rajasthan). It is out of per view of this introduction to deal with each site separately although each one has something new to offer. New dimensions have been added to the personality of the civilization, including phenomenal increase in its geographical extent. A wide range of settlements of different proportions have shown up an amazing scale of hierarchical order, in which Mohenjo-daro, Ganweriwala, Harappa, Rakhigarhi and Dholavira have emerged as metropolitan cities in order of their dimensions, and richness of antiquarian wealth with a remark that Ganweriwala is only explored. However, Mohenjo-daro was the largest, most prosperous and certainly a city par excellence, while Dholavira was the smallest among them, yet it epitomizes the best of planning beside some of the finest elements of architecture, most particularly in the essential components of its fortification systems. It will be pertained to briefly state about it

1.1.17 Dholavira

Like Harappa, Dholavira (District Kachchh, Gujarat, India) is equally important for providing a long cultural sequence, starting for late 4th or early 3rd millennium to the middle of the 2nd millennium BCE, during which, in about 14 m of occupational debris, the Harappan civilization passed through seven cultural stages of nascence, adolescence, adulthood, maturity, ageing, transformation and finally de-urbanization (Bisht, 1989:397-408; 1989b:267-272; 1989c; 1990:71-82;1993), thus revealing a full cycle of the rise and fall of the culture. Thirteen field seasons of excavation from 1989-90 to 2004-05 have presented a

major, model city, which is remarkable for its exquisite planning, monumental structures, aesthetic architecture, a very intricate system of fortifications, two multipurpose grounds or plazas which were also used as stadiums, the larger one particularly was furnished with stands for seating spectators, amazing water harvesting system and a variety of funerary architecture. The site also enjoys the unique distinction of yielding an inscription made up of ten large-sized signs of the Indus script. Another unique find is a fragment of a large slab engraved with three large signs of the script. Arich harvest of antiquities include: a stone statue of an ithyphallic deity, three mongooses, besides a variety of limestone pillar remnants of superb workmanship Besides, there are seals, sealings, weights, a wide variety of jewellery of gold, silver, copper, semi-precious stones, ivory, faience, steatite, shell and clay; tools of copper, stone, shell, etc.; a huge corpus ceramics and other objects. Significantly, the site has also provided three sets of seals pertaining to different chronological stages.

With a view to bringing out complete layout on horizontal scale and ascertaining cultural sequence of all the components the city vertical excavation was conducted at strategic points, new method of grid plan for digging and documenting was devised as a result, the objectives that were set were satisfactorily realized. The work in the cemetery also added entirely a new chapter on the funerary architecture and mortuary practices of the Harappans of Kachchh in particular. The discovery and then study of the Harappan quarry was another significant contribution.

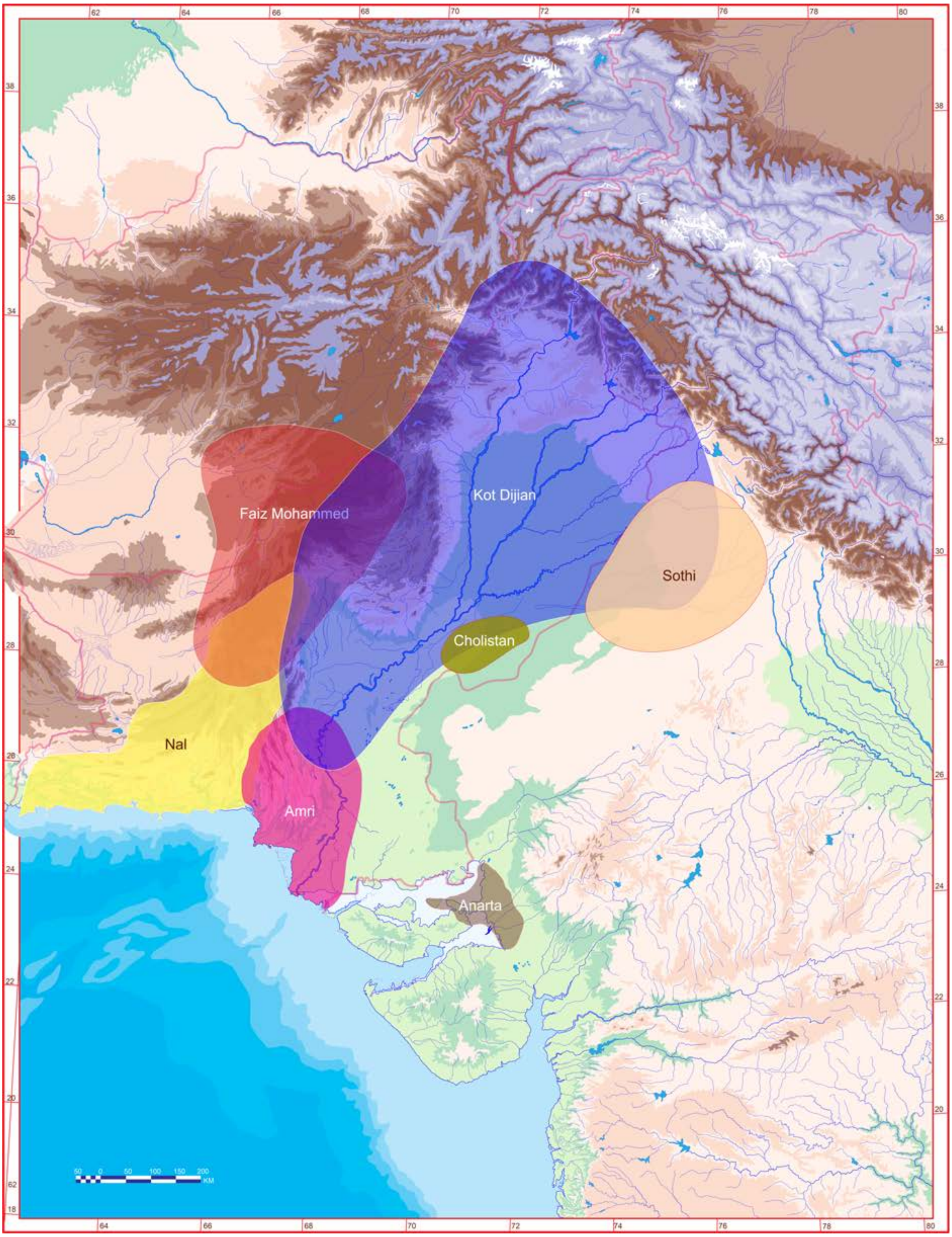


Fig. 1.1: Map showing the proto-urban cultures of south Asia

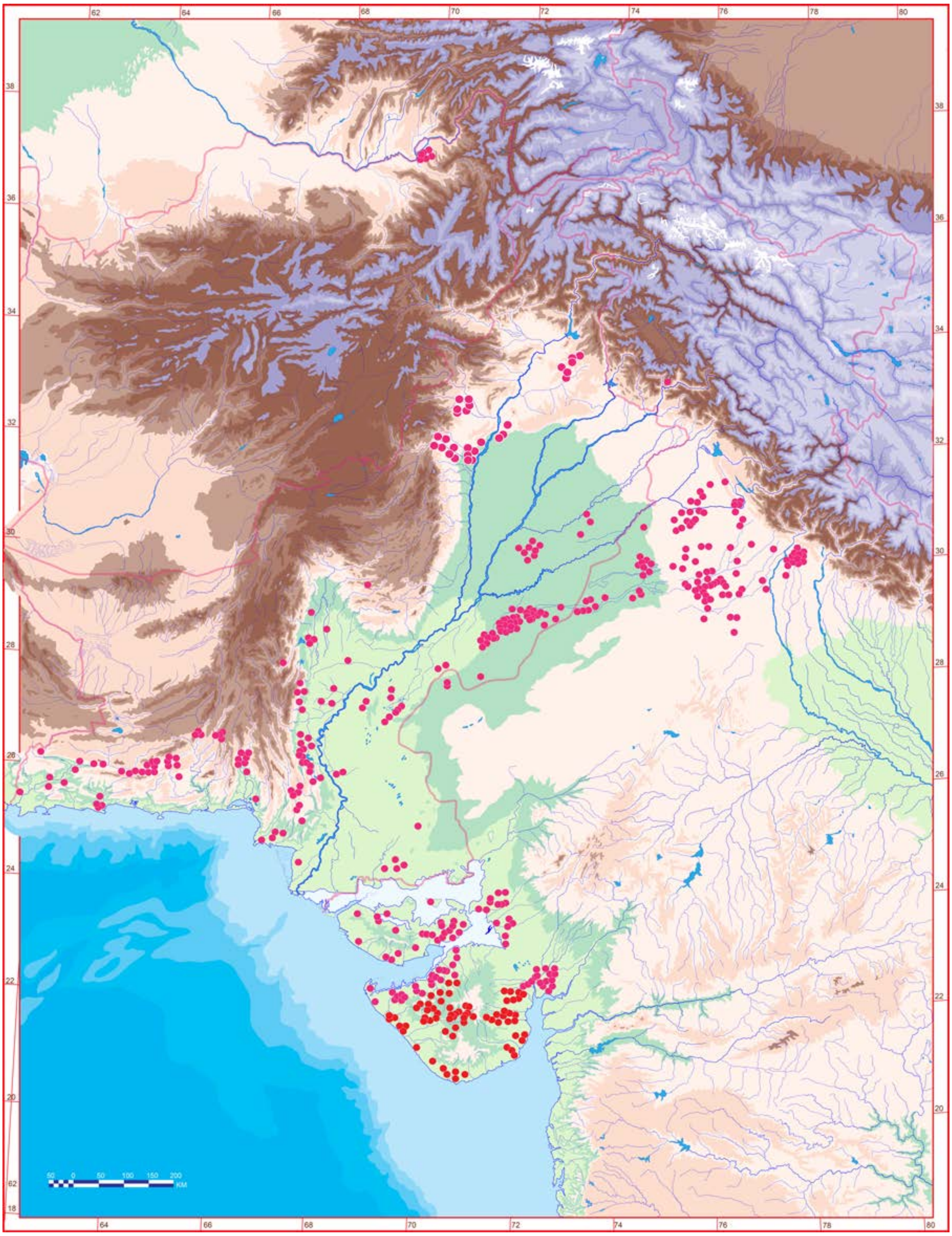


Fig. 1.2: Map showing the distribution of mature Harappan sites

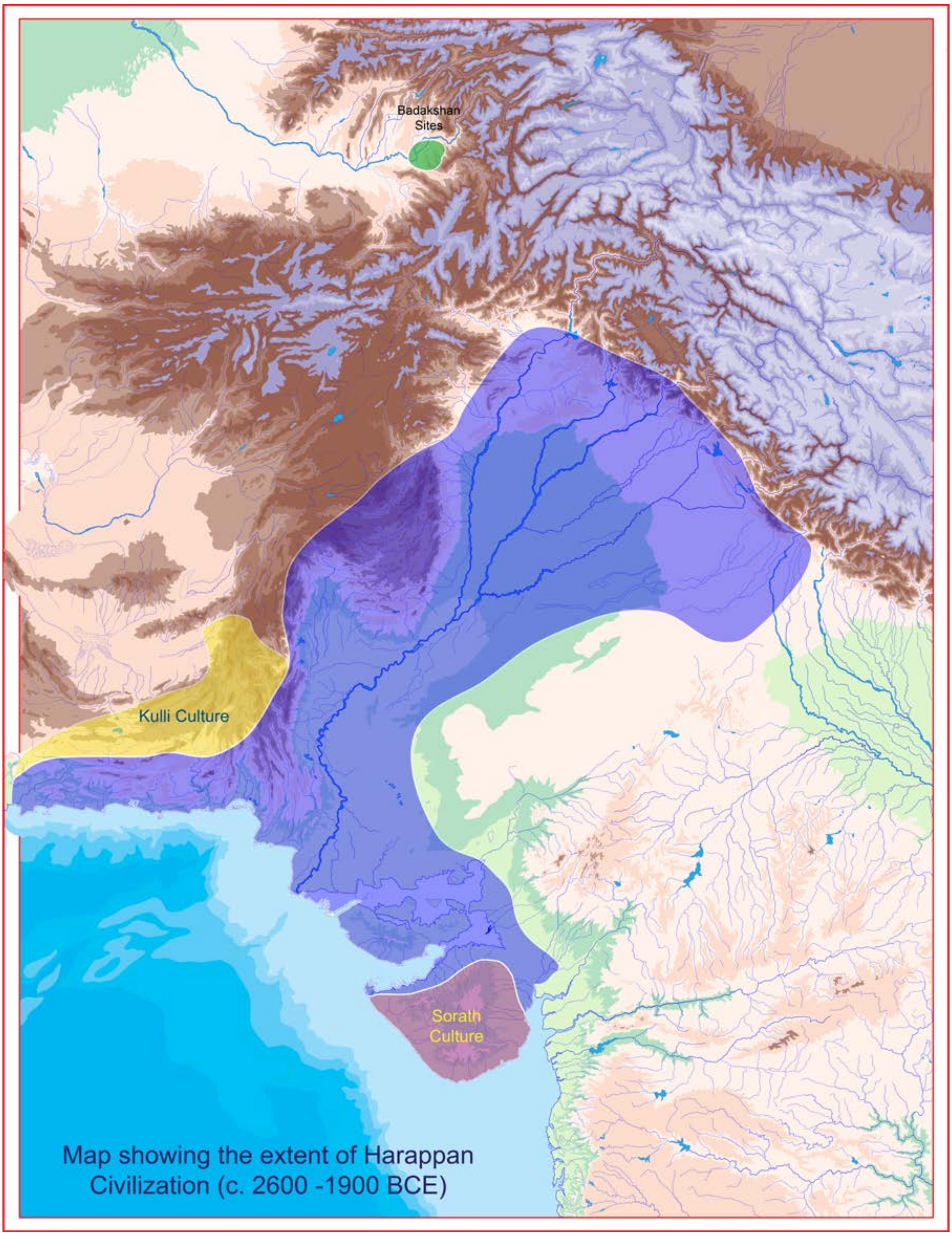


Fig. 1.3: Map showing the extent of mature Harappan culture

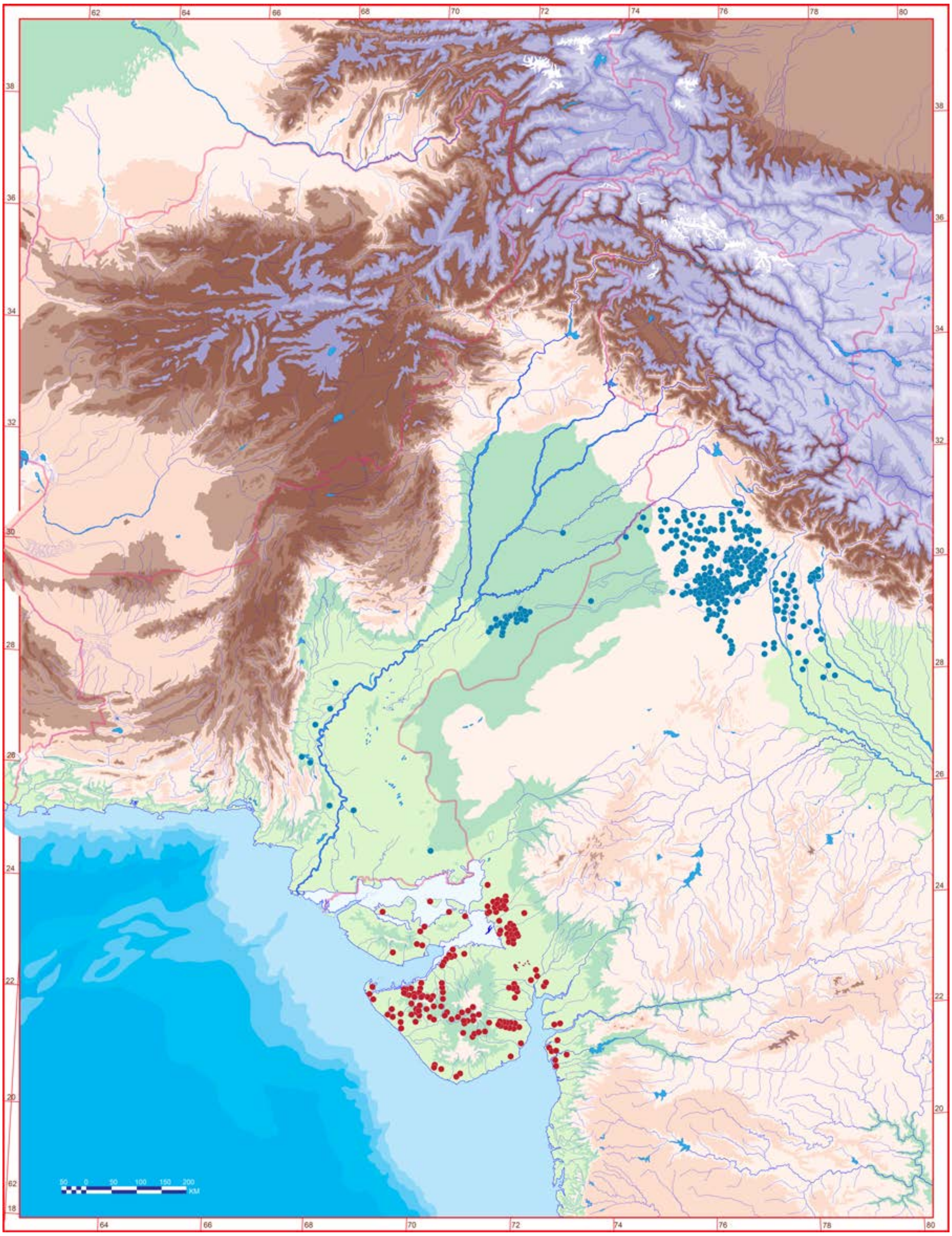


Fig. 1.4: Map showing the post-urban and late-urban (in Gujarat) sites

Chapter 2

2.1 The Site

The ancient site at village Dholavira (23º 53' 10" N; 70 º 13' E), Taluka Bhachau, District Kachchh, Gujarat (India), lies in the island of Khadir, which, in turn, is surrounded by the salt waste of the Great Rann of Kachchh. Two monsoon channels, namely the Manhar and the Mansar, embrace the ancient settlement. The ancient ruins, including the cemetery, cover an area of more than 70 hectares half of which is appropriated by the articulately fortified Harappan settlement alone.

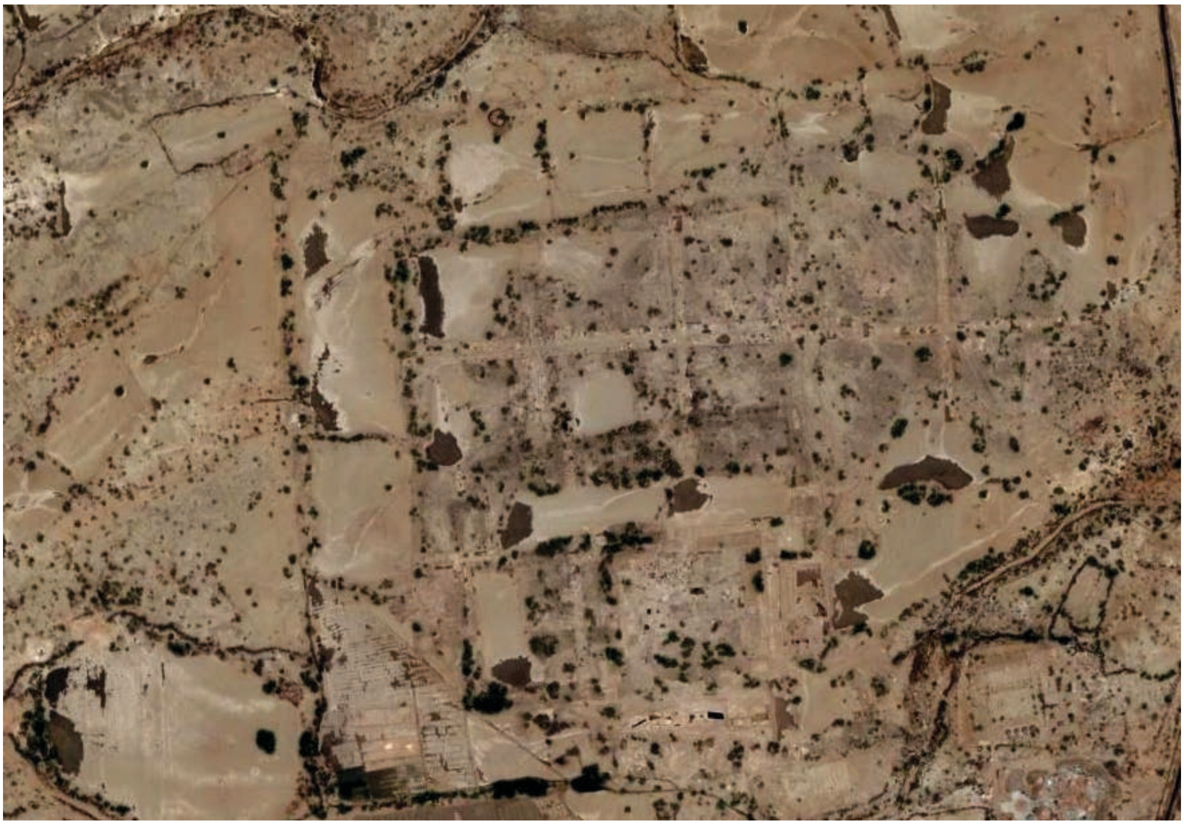


Fig. 2.1: Google Earth image showing the site of Dholavira

In India, Dholavira is one of the two largest known Indus settlements the other being Rakhigarhi in Haryana, and may probably rank the fifth in the subcontinent, following Mohenjo-daro in Sindh, Ganweriwala and Harappa (both

in Punjab, Pakistan), in terms of area coverage and perhaps, in hierarchical status. Ever since their discovery, the ancient mounds of Dholavira had aroused great curiosity among archaeologists. After a lapse of almost two decades, there was carried out a systematic survey and documentation of the visible structures and other features of the mound and their environs. It made it obvious that it was, perhaps, the best-planned Harappan city with several divisions and many new features hitherto unknown.

The mounds, (two of them being locally known as 'Kotada' and 'Bazar' specifically, while the others remaining unnamed), are located less than 1 km northwest of the village. The ancient remains are embraced by two seasonal torrents, namely the Mansar and the Manhar, which emanate from the hills in northeast and flow in their defined beds cut through the motley terrain of rocks and alluvium till they join each other before running into the Great Rann.

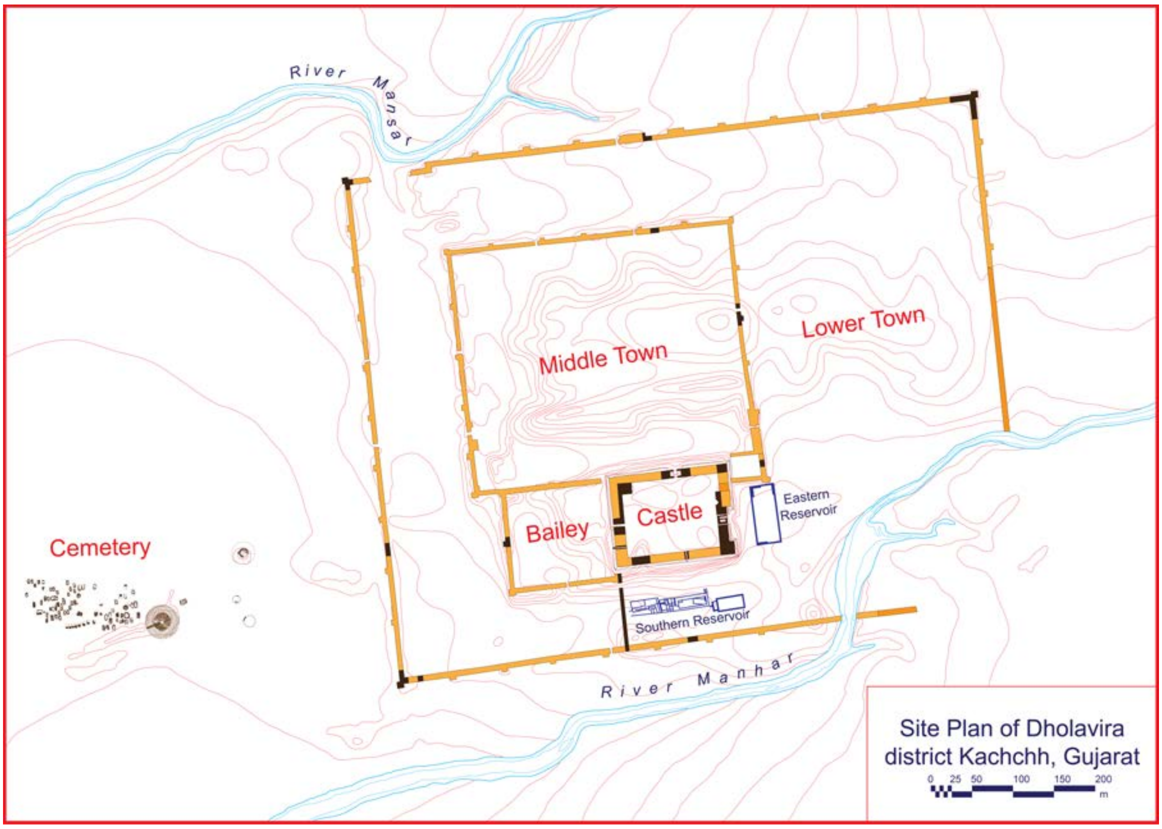


Fig. 2.2: Site plan of Dholavira showing prominent divisions

These are ephemeral streams, which carry a heavy volume of water after downpours in the catchment area but dry up quickly within hours. There is, however, no perennial source of surface water other than the artificial lakes and ponds, which, too, are solely dependent on the monsoon.

However, Dholavira in the entire Khadir is exceptionally blessed with such good groundwater reserve in its soft sedimentary limestone deposits that they did not fail it even during the severest drought that visited the larger parts of Gujarat during the eighties of the last century. The soil is rich and fertile sandy loam although not available plentifully for cultivation as it is largely restricted to a narrow strip running along the Rann from northwest through south to southeast, or to a few patches in an otherwise rocky terrain intersected by numerous torrents, which originate in the northern hills.

2.2 Dholavira

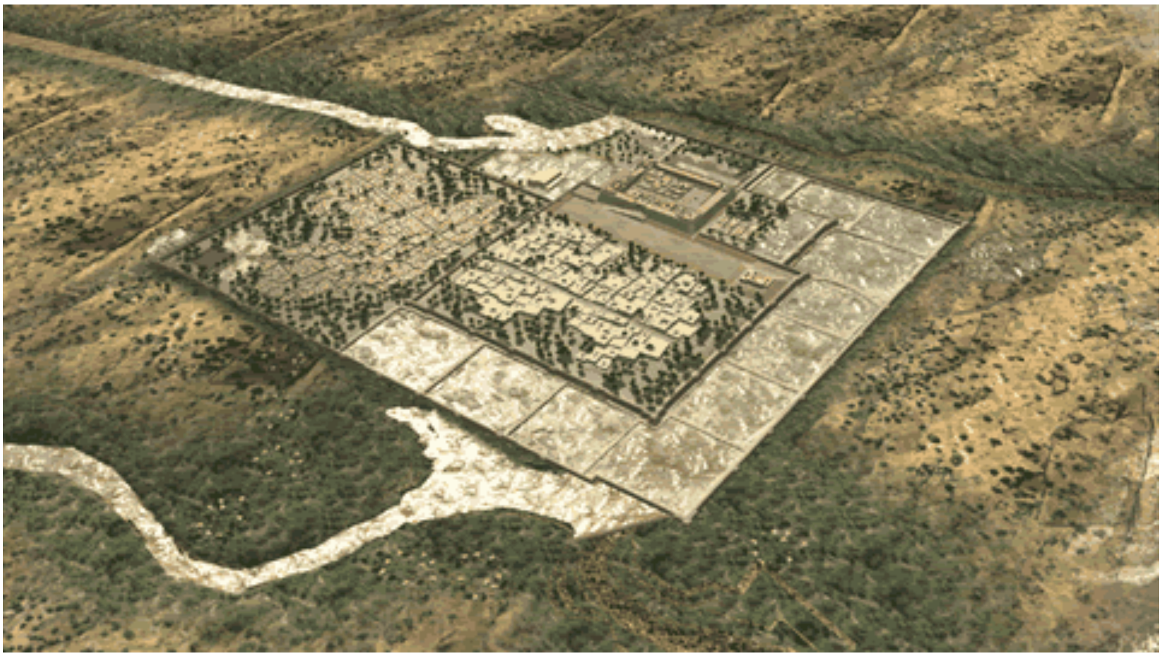


Fig. 2.3: Computer generated image of Dholavira city

Dholavira is a small sleepy village of little pretensions in Taluka Bhachau, District Kachchh, Gujarat (India). It is situated in northwestern part of the Khadir bet (island), which is surrounded by the salt waste of the Great Rann of Kachchh. Dholavira is a veritable emporium of diverse communities. Before the earthquake of 2001, it was an assortment of residential houses of different types and modest

dimensions. Many of them were made of stone set in mud mortar and having sloping roofs of timber, grass and earth, while there were pockets of circular huts of Kolis and Harijans clustered on the margins of the village.

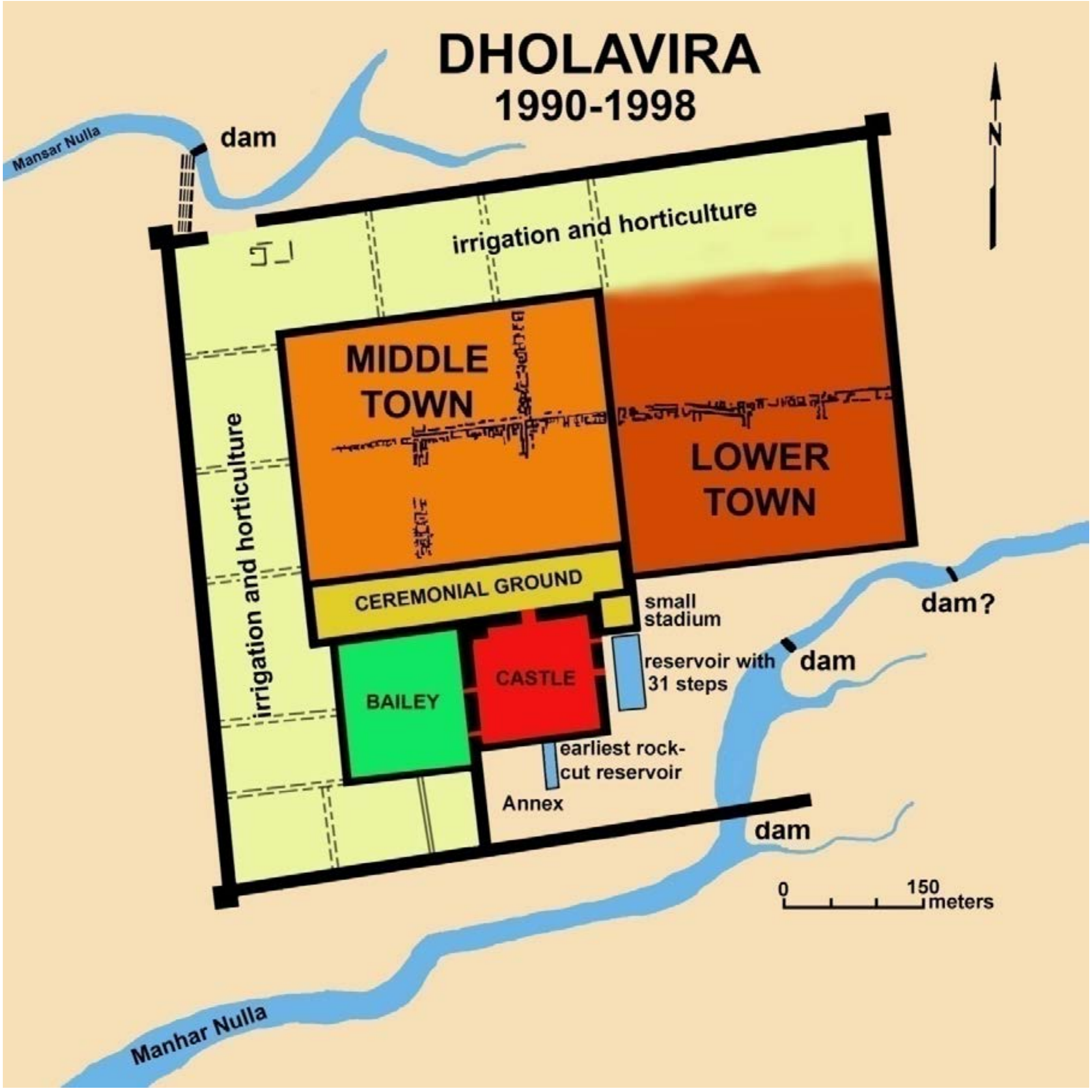


Fig. 2.4: Plan showing the various divisions of city of Dholavira

After the earthquake, only a little, but noticeable, change has come about in that the use of cement, terracotta tiles, and sparingly of brick and cement blocks are used in many of the houses. Hutments are still interspersed in the settlements. There is a little change in life style. Save for two families almost all the people are engaged in agricultural pursuits. Stockbreeding, which was very strong in the subsistence system, has reduced considerably after the severe

drought of the eighties of the previous century when all the domesticated animals either perished or were sent to asylums run by religious bodies in the towns, or taken to faraway lands. This was a great deterrent. Most of the people have stopped keeping large herds of castle, goats, sheep, and camels now. There are now fewer animal heads for milk, tillage or drawing carts.

2.3 The Gujarat mainland

Traditionally divided into north and south by River Narmada, and topographically into (i) the rocky highland on the east and northeast, and (ii) alluvial plains, sheltered by the former, on the west. The rocky highlands have three units known after the Sahyadri, the Satpura and the Aravallis, showing rugged topography and diverse geological building processes. Like Kachchh, Saurashtra and Rajasthan, the Palaeozoic Era is completely absent in the mainland too. On a basement of granite and gneiss of an indeterminate age, there developed the Proterozoic sediments successively represented by the super groups of the Aravalli and Delhi and the post-Delhi magmatic rocks. The super group sediments consist mainly of limestone, quartzite, schist, talc-serpentine schist, calc-schist, calc-gneiss, marble and phyllite all of which duly extend fairly across the Aravallis in Rajasthan.

The magmatic rocks include epidiorite, dolerite, gabbro, andesite and basalt, while the Jurassic formations are absent completely. The Bagh beds of limestone and marl sandstone occur during the lower Cretaceous period of the Mesozoic Era and then start the volcanic eruptions forming the Deccan lava flows of the upper Cretaceous through lower Eocene with its peak period during 65-60 million years. The following Tertiary deposits are made of sandstone, siltstone and conglomerate –the last one yielding a wide range of chalcedony, carnelian, agates, jasper, etc., buried or exposed at several places in the entire state of Gujarat.

The alluvial plains, sheltered by the highlands and forming an arc from the Dadra and Nagar Haveli, run along the coast of the sea and the Gulf of Khambhat and then cover a large part of north Gujarat right up to the LRK. The plains are made up of the Quaternary alluvium topped over a large area with

sand sheet and dune. In the north-west, the plains passes on, through a narrow corridor, into Rajasthan where those open up into the sprawling Thar desert, which, in turn, lies between the Indus valley on the west, the Aravallis on the east and spreads over the southern plains of Panjab in Pakistan and India and extends partly over those of Haryana (India). In its northern stretches, it is dissected by the beds of the Chautang (anc. Drṣadvatī) and the Ghaggar-Hakra (anc. Sarasvati) which are replete with the protohistoric sites ranging from the 4th millennium to the 1st millennium BCE, although towards the last two millennia the area was being rapidly depopulated progressively from the west to east.

The Sahyadri ranges to the south of the Tapti are made of the lava flows (which however continue up to the north of the Narmada). Generally rising between the altitudes of 150 and 300 m, with higher ones in the Dang area attaining 793 m, the hill ranges run roughly E-W carved with shallow and wide valleys of rivers, which flow into the Arabian Sea through the narrow coastal plain. The Tapti is the major river, which was occupied by the Harappans of late mature and later phases, which had been preceded by a local culture, known after the type-site of Savalda. This part is sub-humid in climate, receiving rainfall ranging from 2000 or even more to 1200 mm, hence harbouring luxuriant growth of forest, which is very rich in species.

The segment between the Narmada and the Mahi is the Vindhyan range rising between 150 to 500 m. The area between the Narmada and the Sabarmati is the central Gujarat, which is moderately humid with the rainfall ranging between 200 and 800. The rocky highlands are clothed with forest, which provides a variety of timber, including the teak.

The Narmada, which originates far away in the Amarkantak hills (1150 msl) in Maikala range, which pierces through the Satpura and Vindhyan ranges and then descends into Gujarat where it flows for 150 Km before meeting the Gulf of Khambhat at Bharuch (anc. Bhrigu/Bharu-kachchh).The Mahi and the Sabarmati originate in the hilly highlands and take south-westerly courses in order to flow through the alluvial plains into the Gulf of Khambhat while the

Rupen, the Saraswati and the Banas drain the western plains lying further north and meet LRK in the west.

Further north is southwestern extremity of the Aravalli mountains, which start in Gujarat and then run diagonally from SW to NE in sub-parallel ranges right across the state of Rajasthan to terminate in Delhi. In the central region these ranges make high tablelands. There are numerous rivers, mostly monsoonal. The Luni and tributaries originate in the western flanks of the Aravallis and debouch into GRK in the south, while a few minor ones end up in land-locked lakes. On the eastern part, the rivers, namely the Kunu, Parbati, Kali, Banas, Morel, Khari and Mansa make long and narrow or broad valleys. All these rivers finally feed the Chambal, which flows into the Yamuna to which the Banganga meets separately. In the northern part of the State, there are the Sabi, Kansavati and Kantli, which originate from the northern ranges of the Aravallis and get lost in the Haryana plains or Rajasthan sands. In the northeast, the rugged topography of rock ranges gives way to isolated hillocks and outcrops and then gently merges with the Yamuna plains.

Climatically too, the region of Gujarat and Rajasthan show a great variation in temperature, rainfall and quality of air. The temperature changes from 35^{o}C to 45^{o} or more, the climate changes from hot and humid in south Gujarat and the south-facing Saurashtra coast through dry and semi-arid plains to arid Kachchh and extremely arid Thar. Much variability as well exists in rainfall pattern, which shows three-seasons:(i) monsoon from middle of June to middle of October, (ii) winter from November to February, and (iii) summer from March to June. The first one is the main source of rainfall but its precipitation and duration varies from south to north as well as from east to west. While the south Gujarat is the wettest and, Kachchh and the Thar Desert are the driest: the southernmost part receiving 2000 mm of rainfall which gradually decreases further north and north-west till, it is reduced to almost 100 mm in the western part of the Thar.

2.4 Khadir

Khadir is flanked by two other islands, namely Pachchham and Bela, which stand like sentinels at a distance of 19 km east and 8 km west,

respectively. Its location is also quite curious as it lies approximately in the centre of the Great Rann where the latter is the longest from east to west and broadest from north to south. Beyond the Rann, there lie the Thar in the north and the mainland of Kachchh in the south. **Spreading over an area** of 196 sq. km, Khadir conforms to an inverted triangle. It is a 'tilted block', uplifted along the Pachchham-Khadir-Bela 'master fault' (Merh 1995: 131; Chowksey et al. 2010:467-490). Rising to a height ranging from 107 to 122 m above the Rann, a chain of cliffs which runs straight along the east-west makes the northern side of the island a natural barrier, while, on all the remaining three sides, the land fans out and gently slopes down towards the Rann and thus determines its semi-radial drainage pattern on the habitable back slope, while radial on the whole.

Geologically, Khadir is formed primarily of Miocene (Middle Jurassic) rocks of Pachchham formation consisting of siltstone, shale, marlites, clay stone, coralline limestone, pink, yellow and banded limestone, calcareous sandstone, overlain in parts by the Pliocene sediments of the Sandhan Formation mostly consisting of sandstones with conglomerate, clay stone, laminated siltstone and fossiliferous limestone [Chowksey et al. 2010: 469-471],and is covered along the margins with the Quaternary sediments which slowly merge with the surface of the surrounding Rann (Chowksey, et al. 2010: 483).

There are several highs and lows in the 'back slope', the latter being covered with cultivable soils derived from limestone or sandstones. These geological sediments were extensively exploited by the Harappans by quarrying over three million cubic metres of earth and rock for raising diverse constructions and fabricating an enormous amount of pottery and miscellaneous artifacts mostly for local consumption and partly for export. The limestone of different hues—yellow, banded and black—besides the sandy limestone, is plentifully available and were extensively used.

Particularly, the limestone of fine quality was used for making a variety of architectural members which travelled even as far as Mohenjo-daro and Harappa(Randall 2011: 369-37, 393-94 and personal observation).Dishes and sundry artifacts of the same limestones were also exported to some other Indus

towns, including Banawali (Personal observation). If we look at the quantity of such finished objects, it does not appear to have been such a lucrative trade, which would have added substantially to the prosperity.

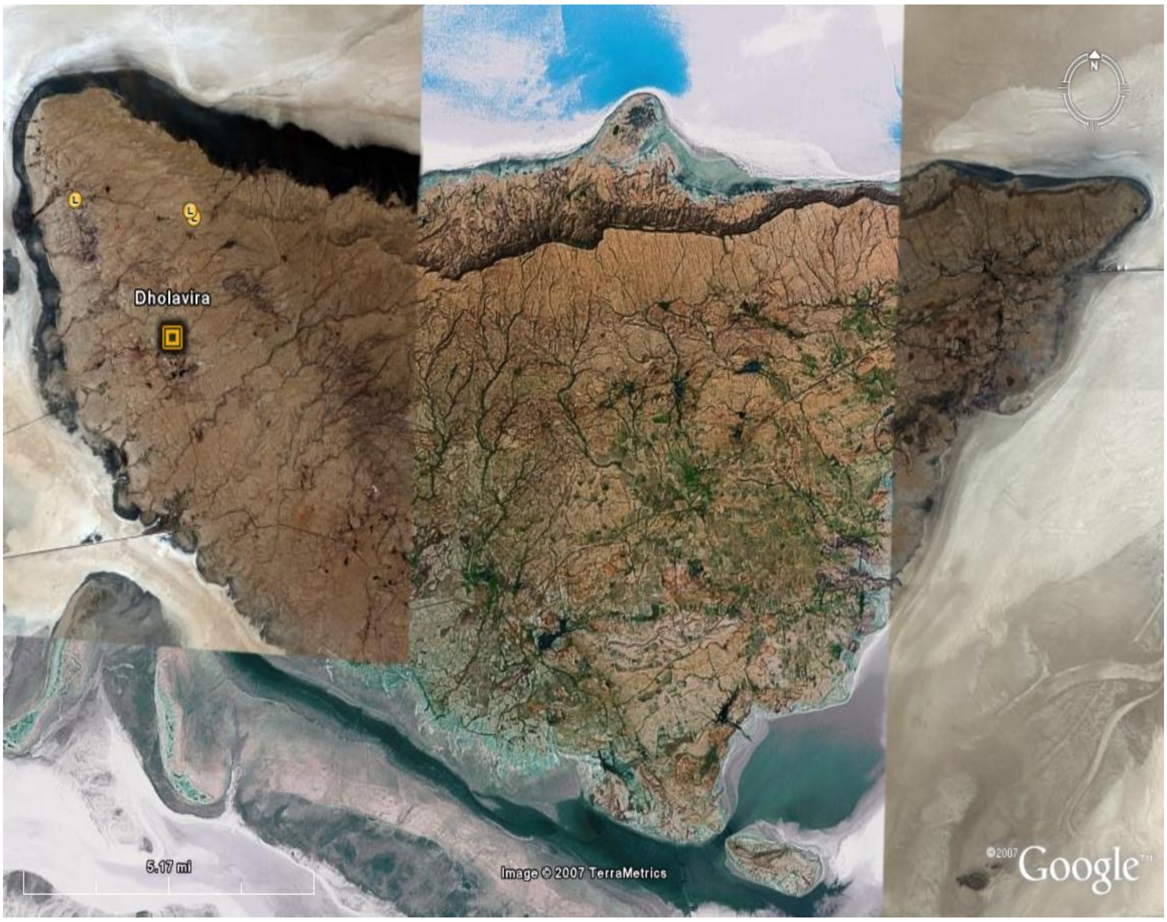


Fig. 2.5: Google Earth image showing the Khadir island

No profitable minerals have been reported from Khadir, although the alluvium around contains a good percentage of small particles of chalcedony, which are too small for any industrial and commercial use. Cheriya Bet that projects into the Rann from the line of the northern escarpment of the island is reportedly covered by a thick scatter of agates, probably thrown up during Miocene. But the pebblets are said to be too small for manufacturing of beads and tools. Furthermore, there are found at places deposits of fuller’s earth, coloured clays and china clay, which are not exclusive to the island. On the whole, Khadir is poor in such resources, which the Harappans could have craved for their large-scale industrial or commercial enterprises.

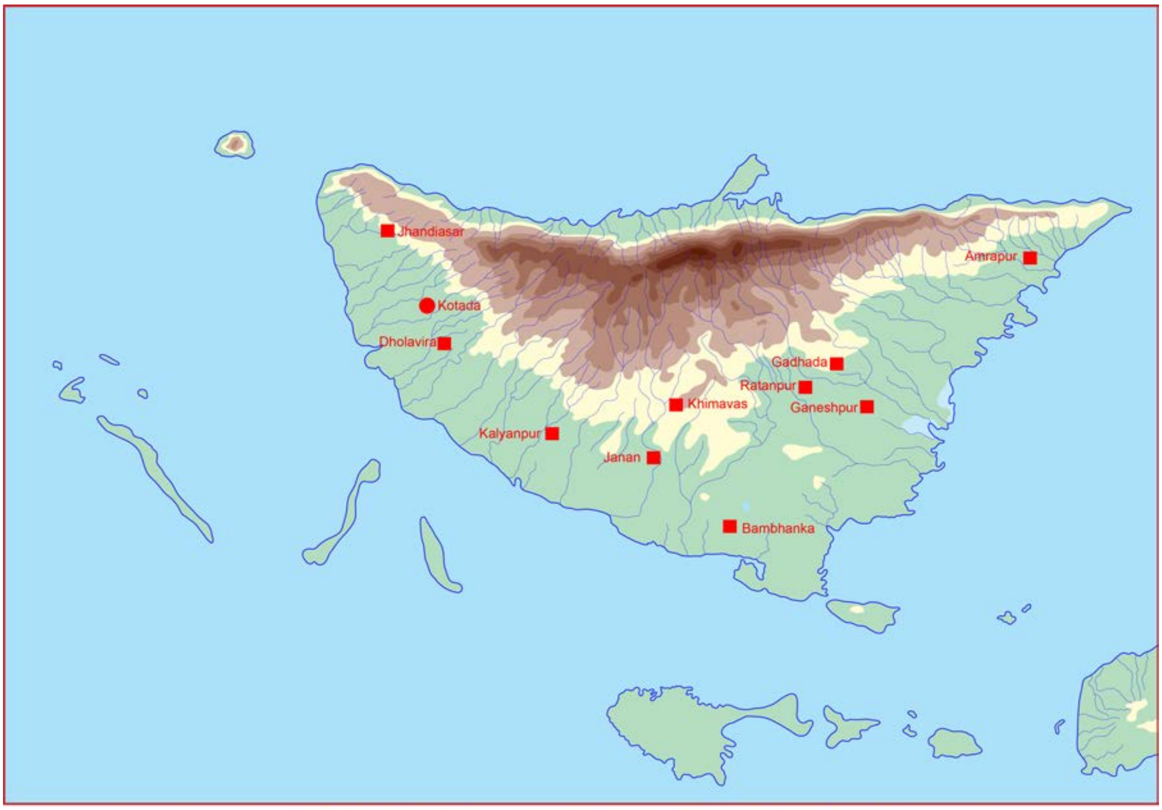


Fig. 2.6: Khadir island and location of Dholavira, district Kachchh, Gujarat

As the terrain is sloping, undulating, rocky and also devoid of water as well as a good and continuous soil cover, the vegetation is very sparse and xerophytic in nature. Anciently, like the rest of Kachchh, Khadir must have borne a denuded look when there were no exotic (*gando bawal, Prosopis julifora*) bushes and trees which now impart a false appearance of greenery. The vast rocky tracks of rock do not allow any growth of trees except for shrubs and grass. There are some trees which can pierce their roots into the rocks but their growth remains stunted and gnarled, hence of restricted use for buildings, or making tools and equipment except for firewood and sundry items or for use in unpretentious rural houses. The pipal, *nīm*, *babul* and a few fruit trees grow under human care only where there is good soil cover. Although Khadir falls in the reserved wild life sanctuary there may be seen few deer, *nilgai* wild hog, hyena, jackal, fox, small wild cats, the great Indian bustard and some species of birds and a great variety of migratory birds including the flamingo. The wild Indian ass (*khargoda, Equu, hemionus*) stray into cultivated fields from the smaller mud islands in the Rann.

Khadir with its meagre rainfall of 262 mm per annum, Khadir stands the second poorest, only next to Lakhpat in the west of Kachchh, whereas the nearby islands are better off in comparison. Wettest months are July and August and partially September, while the winter rainfall is negligible. Therefore, the summer cultivation *(kharif)*are the main crops which comprise pearl millet (*bajra*), great millet (*jawar*), green gram (*mung*), brown gram (*muth*) and sesame, all being the staple food, in addition to wheat that is grown limitedly only where irrigation is possible. It also grows a few cash crops like cotton, cluster bean (*gawar, Tymopsis tetragonoloba)*, cumin, castor seeds and plantago(*isabgol, Plantago ovata*). Cultivation is possible in small patches of sandy alluvial soil. A variety of wildly growing vegetables supplement the subsistence. Cultivation has thus limited potential.



Fig. 2.7: Remote sensing image of Khadir island showing location of Dholavira

Agriculturally, the Khadir is, thus, not a viable land. That is why it supported, according to the census of 1961, hardly a dozen villages having a population below three thousand souls giving the density ratio of 14 persons per sq. km as against the 33.3 for the entire Kachchh. Even now, there are in the

island no towns or markets, save for one or two small village shops keeping sundry provisions for local consumption in a village.

However, the island provides a good pastureland, famous for its nutritious grasses, one of which is *had*, which has lent its name to the island. The livestock comprises cattle, goats, sheep, donkeys and camels necessarily, and horses and buffaloes sparingly. The pets are dogs and cats. For nomadic pastorals, dogs are necessary companions. Milk and its products are also very important food items.

Khadir, therefore, provides a little attraction. The only redeeming feature is its aquifer trapped in the soft and fragile sedimentary rocks of limestone, which has good permeability and water-bearing capacity. The problem arises in the event of consecutive droughts when all artificially created water bodies and wells go dry. This phenomenon is more usual than exceptional. One interesting feature that the author noticed that Dholavira was yielding sweet potable water from its wells all throughout even during those four years of severest drought of the century, that brought about untold miseries. If to leave aside the protohistoric times, Khadir never played any significant political, social, or economic role during historical times. Therefore, on the present showing, the presence of the spectacular Indus town of Dholavira remains a riddle. There should have been some other profitable factors for which it is better to look beyond. It is more imperative in view of the impressive array of the Harappan sites in the land of Kachchh.

2.5 Kachchh

Kachchh (erstwhile Cutch, or Kutch) peninsula lies between the latitudes $23^{0}13'$ - $24^{0}68'$ N and the longitudes $68^{0}10'$ - $71^{0}80'$ E, and forms the westernmost and the largest district of Gujarat State. Geographically, the Rann, the Gulf of Kachchh, the Arabian Sea and the Kori Creek are the most defining features and also pertinent appurtenances of the landmass of Kachchh. These surrounding features render it cut off and insulated from the neighbouring lands and the rolling waters. True to above is a virtual description that was written, some 2000 years ago, by an anonymous mariner or merchant in his famous

guidebook for the voyagers, *The Periplus of the Erythraen Sea* (Periplus 40)[1], is worth quoting as follows (Schoff 1974):

> "Beyond the river Sinthus there is another gulf, not navigable, running in toward the north; it is called Eirinon; its parts are called separately the small gulf and the great; in both parts the water is shallow, with shifting sand banks occurring continually and a great way from shore; so that very often when the shore is not even in sight, ships run aground, and if they attempt to hold their course they are wrecked. A promontory stands out from this gulf, curving around from Eirinon toward the East, then South, then West, and enclosing the gulf called Baraca, which contains seven islands.

Physically, the Great Rann (hereinafter GR, and likewise other oft-repeated names are abbreviated as given in bracket against each) separates Kachchh from the Thar Desert (Thar), alias the Great Indian Desert, on the north, it along with the Kori (earlier, Cori or Coree) Creek from the Indus Delta(Delta) on the west, the Little Rann (LR) from the north Gujarat plains in the east, this together with the Gulf of the Kachchh (GoK) from the Saurashtra peninsula in the south, while the Arabian Sea washes its south-western shore. The bordering Thar and Delta form parts of the province of Sindh in Pakistan, the others pertain to the state of Gujarat.

Kachchh is an appropriate name for a land surrounded by water bodies as defined in the *Amarakośa* [II.1.10, III.4.31].Pāṇini speaks of *kāchchhī*cattle (*Ast*. IV. 2.134) or cites *kachchha* along with other terms as characterizing suffixes to geographical names of different kinds of places or regions (*Ast*. IV.2.126; see also IV.2.133, *kachchhādibhyaścha*).There is however, no solid reason to assume that *kachchha* occurs as a name of a country or state (Majmudar 1960:287).The entire Vedic literature, too, is silent in this regard. The *Mahābhārata* which is extremely prolific in enumerating, on several occasions, a

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[1] Periplus 40 in Schoff 1974: 38: The writer is said to be an Egyptian Greek, possibly settled at Berenike, an ancient Egypian port at the head of the Red Sea and identified with the ruins in Umm-el-Ketef; has placed the author in second half of the 1st cent. CESchoff- 1974:7-16 (cf. Ray 1986: 6, 38); Sinthus is obviously the Indus; Eirinon (Sanskrit *iriṇa) is the Rann of Kachchh;* the Gulf of Baraca is (Dwarka, i.e. the gateway, on the north-western sea-shore of Saurashtra, now called) the Gulf of Kachchh.

huge number of peoples or countries (*janas* and *janapadas*) of the entire subcontinent, and even of the outlying regions, makes only a solitary reference to *Kachchha* along with *Gopālakachchhah* among upwards of two hundred others. It, perhaps, became a little better known during the early historical period; particularly when Gujarat came under the Mauryan sway during the 4th century BCE. Occasionally, it occurs in the later texts (Majmudar 1960:296). However, local tradition relates its name to *kachchhapa*, a tortoise, to which its form resembles. This seems vaguely reflected as well in an epic tradition [Mbh. 3.82.103-07],[2] according to which Koti-tīrth, identifiable with the famous Kotesar on the western coast of Kachchh, was ravaged (stolen) by a demon by assuming form of a tortoise (*kūrma*) and later restored by Viṣṇu.

Kachchh has been rightly called 'The sea-coast land', having 'the elements of a distinct nationality' [Imp. Gazetteer of India, Bombay Presidency vol. II 1909: 326], obviously in consequence of its geophysical situation. Lying on the Tropic of Cancer, it runs for a maximum length of 320 km E-W and width of 170 km N-S likewise, and covers an area of 45, 612 sq. km [GSI 2011:1]. Physiographically, it comprises four geomorphic types, viz. (1) **the hilly regions** (2) **the southern coastal plains**, (3) **the low-lying Banni plains** and (4) **the Rann**; owing this diversity to 'the factors of geology, climate and sea level change' (Merh 1995:5).

1. **The hilly regions** comprise three units: (a) the east-west trending **central rocky mainland** marked by hill ranges, valleys, plateaus and cultivable plains; (b) **the Wagad** having similar features as(a) above. (c) **The island belt** represented by four major islands, namely, Pachchham, Khadir, Bela and Chorar, thrown up in the Rann, and running from west to east.

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2 Mbh.3.82.103-07: identification of Koṭi-tīrtha with Kotesar sounds plausible due its being preceded by Soma-tīrtha in Saurashtra and followed by Nārāyaṇa-tīrtha, present-day Narayan Sarovar, not far from Kotesar, and Udap*āna*much further northward. The first and the last ones are referred to in similar sequencein the great epic [Mbh.9-34.37 to 9.35.1, 53], however with a note that Soma-tīrtha in the critical edition, just referred to and generally followed, is replaced by Mahe*ś*vara-pada instead, although footnotes in the same does state that the former duly occurs in some of recessions, and it is correct as Balarāma started his upstream pilgrimage along the Sarasvatifrom Prabh*āsa*where (Soma) Chandramas (the moon-god) lost his luminosity under a curse, later relaxed to the phases of waning and waxing (Mbh. 9.34.37-75).

2. **The Southern Coastal plains**, extending from the Kori to GOK with a seaward slope, comprise 'raised beaches, raised mudflats, abandoned coastal cliffs, uplifted estuarine tidal to fluvial terraces and stabilised coastal dunes [Maurya et.al. 2008:746-758].
3. **The Banni plains** are the uplifted Rann surface to the height of about 2 m with a gentle northward slope between the rocky highland on the south and the GR and Pachchham on the north. It is reputed to be an excellent pastureland, which has been considerably spoilt now by the exotic Prosopis julifora grown wild in, abandon.
4. **The Rann** is a saline wasteland that rises from 2 m to 6 m above the mean sea level (msl) and encloses as already mentioned a the land mass of Kachchh, , on the north, east and south-east and is connected to the open sea through the Kori Creek and the GOF. In summer, it goes under up to 3 m of water, contributed by the sea and the monsoon rains and run-off. Evidence goes that it has considerably influenced the destiny of the land in the past.

The above physical features of 'highlands', 'islands' and 'residual depression' of the Rann are controlled by the E-W trending major faults. The former two, excepting Wagad, are thrown-up, tilted blocks with northern faces rising high and the southern parts gently sloping to make peripheral plains, whereas Wagad shows a northward tilt and its 'southern flank has a complicated margin made up of faults and flexures.

2.6 Geology

Kachchh has a distinct geological personality which has been thoroughly studied and revised from time to time by many a field geologist, while the Rann, for that matter, is far less studied – the work being mainly confined to coastal margins on shore or a little off shore.

Kachchh was a palaeo-rift basin, which dates back to the early Mesozoic times, when the Indian landmass was part of the Gondwana Supercontinent (GSI 2011:2). The rest is a long history of breaking off the Indian subcontinent and its northward drift which was checked by its collision with the Asian plate during

Eocene-Oligocene of Tertiary period of Cenozoic Era, 45-40 million years ago, when the Himalayas started rising, but before that, soon after 65 million years, there has occurred the Deccan volcanic eruptions for a period of nearly one million years (ibid). Earlier than this, the western margin of the Indian shield underwent rifting along certain Precambrian structural trends, thus leading to the development of three basins, i.e. Kachchh, Cambay and Son-Narmada-Tapti. These rift basins, separated by the Saurashtra horst, played hosts to thick sedimentation of different ages and volcanic activity (ibid).

There developed in the Kachchh rift basin, on a basement of Precambrian syenite of an uncertain age, a continuous story of sedimentation during the entire Mesozoic and Cenozoic Eras, with phases of lava flows between the two, while the whole of the Proterozoic and Palaeozoic Eras are conspicuous by their absence. The Mesozoic sediments, accounting for 2000 to 3000 m of thickness, are represented by successive formations of the Jhurio, the Jumara, and the Jhuran. The first one consists of limestone and sandstone, the second of shale and oolitic limestone and the third of sandstone and shale – all three pertaining to the Jurassic period and the next that follows is the early Cretaceous Bhuj formation which is made up of sandstone, conglomerate and shale, [Merh 1995 25-29, 143]. Identically the Precambrian granite and the Aravalli rocks are exposed in the Maruda hill in GR and Nagar Parkar in the Thar, on the other side of the Rann. (ibid.132, Maruda bet lies about 25 km from Khadir).

'Quaternary record in Kachchh is rather poor and fragmentary': some conglomerate and grit deposits and dunal accumulations of milliolites are assigned to Pleistocene while the sediments in Rann and raised mud flats, terraces, beaches, etc. along the coast are attributed to Holocene[Merh 1995: 156-161; Glennie et al. 1976:625-47; Chowksey et al. 2010: 467-90; Maurya et al. 2008:746-58].

Admittedly, the Rann sediments are only marginally studied. A thorough multidisciplinary study may throw a valuable light on changing patterns of past climate, sea level changes, flora, fauna and episodes of palaeo-seismicity and droughts during the last ten thousand years. Status of all those, particularly

during the last five thousand years, may have direct or indirect bearing on civilizational processes in Kachchh to a great extent.

Kachchh offers an excellent opportunity for making a comprehensive ergonomic study in order to understand the relationship between the Harappans and their environment as well as their relationship with the cereal-surplus Indus-Ghaggar plains. Another aspect is the availability evaluation of the mineral resources. These are however quite limited in Kachchh. Yet, some of them could have been of commercial and industrial uses for the Harappans. For example, according the District Gazetteer of Kutch(now Kachchh), the mineral extraction data pertaining to the year 1961 alone amounted, in terms of tonnage, to 10 agate, 540 white clay, 7 china clay, 20 other clays and 30 gypsum, respectively leaving aside the plentifully available building stones which were used for making ornate or useful articles. Among useful clays are fuller's earth and ochres. Some of them might have been collected, used and marketed straightaway by the Harappans. Quite plausibly, such minerals might have attracted the Harappans to come and set up mining, manufacturing and commercial organizations.

Cryptocrystalline, widely known as agates, are available in Kachchh. We first draw attention of archaeologists to huge deposits containing a variety of agates, carnelian, jasper, chalcedony, chert and mudstone in the form of nodules is present in the Mardak Bet(locally pronounced as Medhok or Mardhok as well), situated in the middle of LR, 8 km away from the western shore. Sixty-one metric tons of agates were extracted from here in the single year of 1961 alone [Dist. Gajett. Kutch 1961, Bisht 1989 a & b). Dist. Gaz. Of Kutch 1961. It is, in fact, is named after Captain McMurdo, the British resident in Kachchh (1809-20), who died there due to cholera and was buried at Varnu village on the western shore of the Little Rann, where a small cenotaph stands in his memory. Countless heaps of rejected nodules can still be seen there over considerably large areas on the island. These contain split, broken, window-opened pebbles and resultant debitage]. Significantly, on the western shore, opposite the island, there is located Khandaria mound in village Varnu which yields, besides the protohistoric pottery, a scatter of tools and debitage of chalcedonic stones, obviously brought there from Mardak. Another agate-bearing locality, near Surkotada, is Khandek

which also yields a considerable deposit of agates, where there is a historical site. A few more agate-bearing sites, namely Adesar, Antaryal, Bhuvad, Dagala, Kherag Khegarpur (sic Khengarpur) are present in Kachchh, though yet remain to be investigated from archaeological point of view.

Limestone, usually yellow, banded with yellow and pink or brown bands, were quarried in the neighbourhood of Dholavira for making special architectural elements such as pillars, door sills, lintels, free-standing columns, in addition to weights, balls, dishes and beads, mostly for local use although some were exported to what quantity is a matter of study. A beginning has been made (Randall 2011:).in addition, grey limestone found in Pachchham has also been used, albeit in lesser quantity and fewer purposes. A variety of calcareous sandstone and many kinds of sandstones have been used, as already indicated, for construction as well as making a wide range of tools, equipment, a few figurines and many miscellaneous items.

Basalt has been used for making dishes and other sundry items. It seems to have been brought from the mainland.

Sand of good quality is available plentifully and may have used as the basic raw material for making faience.

Gypsum, this hydrated calcium sulphate, was used by the Harappans for making a few jewellery items (beads, bangles), dishes etc. The individual signs of the famous Dholavira inscription were made of it (Manual Joseph's analysis). This mineral is widely present in the Tertiary rocks and the Rann sediments in Kachchh. [Merh 1995: 173; GSI 2001: 65-66]

Ochres of red and yellow varieties are associated with the laterite-bauxite at Bhachau, Fulra, and Garia hill, Julrai, Letri, Madh, Umrasar and Wandh [GSI 2001:73].These have many uses. Ferriferous earth and grits, found near Rapar, are brought, especially by potters, for preparing paste special effect of slip and decorative motifs on pottery and terracotta figurines, by householders for decorating houses. Similarly, bright yellow colour is obtained from rocks. Dholavira area is rich in in providing variegated clays of white and pink colours which were extensively used during the periods from stage I through III for

making bricks and also for mortar used for applying plaster and laying floors, making troughs as well as pottery. This clay is found in both petrified and soft clayey forms.

In addition to above, Kachchh offers calcite, kaolinite, kaolinitic clays, tuffaceous stone and many other lithic materials used at Dholavira.

2.7 Marine resources

Marine resources should have been another area of exploitation for shells, bivalve shells fish and other aquatic fauna.

Shells of different species have been used for making ornamental and utilitarian objects. Use of marine shells have recorded from the early farming days in 7th / 8th millennium BCE at Mehrgarh and it continued more and less all throughout, but the Harappans multiplied its use on a very large scale; the finished products as well as manufacturing waste can be seemed everywhere, even in the riparian plains, far away from the source. With the Harappans, it had become a full-fledged industry and evidence from of Nageshwar (Hegde 1990:) and Bagasra (),both lying on the Saurashtra coast of GoK, have turned out to be great centres of shell working by the Harappans and Dholavira did not lag behind bear eloquent testimony.

Kenoyer (1984: 49-63) has shown that five species of univalve gastropods and tree species of bivalve pelecypods have been used by the Indus craftsmen. He has demonstrates that each species of univalve shells has its own merits: *Turbinella pyrum*, (Linnaeus)is suitable for making bangles from its globose body and large solid objects from the central column; *Chicoreus ramosus*, (Linnaeus), for making circlets, ladles, spoons and cups; *Lambis truncatasebae,* (Roding) and *Fasciolariatrapezium*, (Linnaeus), both for manufacturing a variety of inlay pieces and figurines; and *Pugilina buchephala*, (Lamarck), is used for making circlets and a few other things. Each of these grow in different micro-environmental conditions in GoK.*T. pyrum*, which was extensively fished, collected and used by the Harappans, grows in the intertidal zones at Okha, Aramda, Positra, Azad, Wadinar, Bhaana, Salaya, Sikka, Pirotan island and Badi on the southern bank of the GoK. (Nayar et al. as quoted by Gaur ibid.).

Among the three species of bivalves, which were used, albeit limitedly, by the Harappan craftsmen, are *Tivela damaoides*(Gray), *Meretrix meretrix*, (Linnaeus), *Callista impar* (Lamarck), and, at least, *T. damaoides*, is found in GoK (Kenyor ibid: 51, 53). Menon et al have reported 72 species of gastropods from the GoK (as quoted by Gaur ibid 2005: 943). Gaur and his team have collected 35 species of shells from their excavation at Bet Dwarka, an island in GoK, and reported that these were used for food (ibid. 942).

The sea and other water bodies may have provided fish, lobsters, prawns, bivalve shells, etc., as items of food. Furthermore, it has also been evidenced that the marine fish were not only locally consumed, but also dried and exported to as far as north Harappa from the Makran coast (Belcher 1994: 129-141). In addition to all above, these waterways were important in trade and commerce.

Kachchh of today presents a harsh and inhospitable, rather hostile, environment for human occupation. It is a barren and rocky terrain having isolated eminences or hill-ranges in the central part along with of the islands. The picture is nearly what has been seen in connection with Khadir. The drainage is radial in pattern; there is no perennial source of potable water on surface; rivers are ephemeral; rainfall is meagre, ranging merely from 200 to 350 mm per annum, that too erratic; oftentimes it fails altogether even for consecutive years for the reason that the entire region sits on the margin of the rain-bringing influence of the south-western monsoon belt while the winter precipitation is almost negligible. Rainfall decreases from east to west. As in Khadir, it has a good reserve of the groundwater in the limestone sediments, but not all over. It is sweet, potable and productive in the central and N-W areas, while elsewhere it is, by and large; too brackish and saline even for animal consumption and irrigation. Consecutive spells of drought, which have not been infrequent in the past, render all wells dry and, therefore, often cause large-scale migrations of population along with their livestock. We are eyewitness to this during the oft-mentioned recent drought lasting from 1984-87, whereas in Khadir it persisted for two years more.

Kachchh is not a viable land for concerted crop production. Out of the total area, as estimated in 1950-51, only 15.5%, measuring, 25,700 hectares was under cultivation and 75% was under forest and pasturage. Soil cover is poor, scanty and available in patches or on the coastal belt. There were only 937 villages and 6 towns supporting a population of 7 lakh persons, thus giving a poor density. Yet, the majority of the population is engaged in cultivation and livestock farming. In order to understand the present cropping pattern, we may look at the data of 1950-51 when modern irrigation facilities and advanced reclamation techniques were far less comparatively.

The crops raised in order of preference areas per what has already been mentioned above in connection with Khadir. To those may be added cotton, sugar cane and coconut trees, which are grown in the wetter costal area lying between Anjar and Mandvi. The winter crops (*rabi*) accounted for a mere 4% of the cultivated area. It may be borne in mind that whatever little *rabi* cropping that was being practiced owing largely to the state welfare works and modern technology which were certainly less than satisfactory. It sounds anathema while wheat and barley were the staple cereals of the Harappans.

If to examine another area of interest, Kachchh has been fabled for being a vast grazing land. Traditionally, livestock farming is also a major source of subsistence to offset the usual agricultural deficit. The cattle, buffaloes, camels, sheep and goats make a common sight everywhere in Kachchh. It is why the livestock were seven times the human population(ratio 7:1) just before the hard-hitting famine. Large-scale pastoral practice goes essentially hand in hand field cultivation. Besides, there are *rabaris* who are traditionally making a nomadic pastoral community, constantly on the move within and without Kachchh, travelling far and wide all over Saurashtra and Gujarat. They can however be seen as far north as Panjab, Haryana, Uttar Pradesh, as far east as Madhya Pradesh and even Maharashtra in the south during the time of duress .It has been said that the Kachchhi cattle were held in esteem even in the past. Its horses and camels prized in the medieval times.

Under these circumstances, probabilities are higher that the Harappan interests in occupying Kachchh should have been other than the agrarian. This land might have been far less inviting for them who were raising the winter crops which were the mainstay of the Harappans unless there was a better climatic region or better irrigational facilities or the cereals were largely imported from the fertile north and west in lieu of precious things which were lacking in those areas. It was during the later times when the Harappans adopted the summer cropping pattern. Among several probabilities one is they were cultivating the cotton or some cash crops for lucrative return in the domestic and international markets.

The next option is to visualize that the climatic conditions, particularly the rainfall during the 3rd millennium B.C. was more favourable. On this issue there are two diametrically opposite views by the environmental scientists. That makes a separate subject to be discussed separately later on.

Further, it should be reiterated that Kachchh lies on the margin of the monsoon belt. A little shift in its direction towards the east or north could have brought about a considerable change for both, better or worse. May that be so it makes the situation interesting all the more. In southern Punjab, north Rajasthan and Haryana, the Harappans preferred to occupy or reclaim the fertile floodplains, carved out by the rivers, seasonal streams, storm-water channels or relict channels which drain or get flooded by the monsoon run-off. They normally avoided the extensive sandy areas falling in between save for grazing the livestock. It should not be irrelevant to stress that the hugely intricate economic structure that the Harappans had built could thrive on a sound agriculture for supporting the teeming population and as well for proliferating diverse pursuits in the fields of industry, trade and commerce and miscellaneous vocations ancillary to advanced urbanism.

Naturally, Kachchh does not fulfil the requisite qualifications to be an agrarian state. It becomes, therefore, even more imperative to comprehend the palaeoclimate as well as ergonomic mechanism so that the palaeo-environmental conditions and land-man relationship existing during the Indus times are understood better. After all amazing evidence of damming streams and storing

water in a chain of intramural as well as extramural reservoirs, demanding huge investment of money, labour and time on the part of the Harappans point toward that the water highly precious commodity in an environment which may not have been much more merciful than what previous now.

Now arises the question of communication system within as well as without. Interestingly, the time-honoured land routes in the central as well as northeastern zones which have been subjected to greater attention have yielded a series of sites (Joshi). Obviously, the traditional land routes have been in continuous use since remote times. The Rann has never been a barrier to connect Kachchh with Sindh and the Thar towns on the one hand and Saurashtra and Gujarat mainland on the other. Like Khadir, Bela, Pachchham, the northern, central and eastern Kachchh have yielded more than sixty. Indus sites, and may yet further more. It may be reiterated that, sites are present along the shores of the Little Rann and the Gulf of Kachchh across which there are several routes giving access to the of north Gujarat mainland and the peninsular Saurashtra. Likewise, Harappan sites have been located along the dry Nara-Hakra in Sindh. Thus, a network of land communication has started emerging. Joshi, therefore, holds that Harappans entered Gujarat through the land routes passing through the Ranns (Joshi), not via sea as postulated by Rao while discussing the location of Lothal (Rao)

Therefore, there is another line of investigation. After all, the Harappans were acknowledged seafaring people. Kachchh is gifted with a 320 km long coastline with several favourable points for anchorage. During the historical times, Kachchh have been a maritime state having famous ports like Lakhpat, Koteshwar, Jakhau, Mandvi, Mundra, Kandla, Tuna, Jangi, Khariohar, etc., from where the cargo ships sailed to the Persian Gulf, Red Sea, Oman, east Africa as far as Zanzibar on the one hand, and Bharuch, Surat, Bombay, Cochin, Eastern Coast and beyond on the other.(Bisht Imp Gaz.).Kachchhis are well known as a very adventurous and enterprising people. The trade and commerce has however been concentrated in the hands of a few traditional business communities which possess fabulous wealth and are known for their entrepreneurship for long. Nevertheless, it apparently sounds intriguing to record that the marine coastline

of Kachchh as well as of the adjoining Saurashtra, round which the Harappans were believed to have taken a voyage from the Indus to Lothal, has not produced so far any settlements of early or mature phases. On the contrary, the presence of the settlements of those phases on the shorelines of the Rann as well as the Gulf, including either bank of the latter makes the situation quite curious. There is a chain of mature Indus sites along the Rann as well as GoK: Nageshwar, Kuntasi, Bagasara on the southern coast of the Gulf (in Saurashtra), Sewakia, Shikarpur on the northern coast(in Kachchh), Kanmer, Surkotada, Maur, Dholavira, Ratanpura, Juni Kuran on the shore of the Rann prove the point, besides there are many more in the adjoining hinterland of Kachchh. On the contrary, there is a dismal dearth of such sites on the Arabian coast. This could not have been without a reason. Do the Ranns hold the key?

2.8 The Rann

A change in the character of the Rann during the past five thousand years could or might have tremendously influenced the spread, progress, nature and pattern of settlements of the protohistoric cultures in Kachchh and the adjoining areas. A thorough study of the past and present of the Rann is therefore imperative. The Rann is among the unique geographical features in the world. Etymologically, it is derived from the Rigvedic '*iriṇa*', as a kind of water body, identifiable with Ref. 'Eirinon' of the *Periplus of Erythrean Sea* as well as 'Rinn' in the older maps of India. Geographically, it appropriates a large tract of 23,000 sq. km and is arbitrarily divided into two parts, namely the Great Rann (GRK) in the north and the Little Rann (LRK) in the east. In fact, it is a cheerless and desolate mudflat, salt waste, exhibiting a complex inundation pattern. It is connected to the Arabian Sea through the Kori Creek in the west and the Gulf of Kachchh in the southeast, and lies just above 2 to 6 m msl (Maurya et al. 2009:71). In the beginning of the summer, the seawater, aided by the strong southwesterly wind, starts encroaching upon the mudflat and gradually covers it with a sheet of water that almost reaches Pachchham. The monsoon channels from the surrounding regions further contribute a large volume of water and, as a result, the entire tract goes under water, which is generally 30 to 90 cm thick although, at places, it is deeper than 2 m. From November onwards, it starts

drying up fast and a crust of glistening salt covers it all over but for a few wet patches here and there.



Fig. 2.8: View of Rann of Kachchh

A vivid description given in the *Periplus,* already quoted earlier in verbatim (Schoff 1974: 38), indicates that both the parts of the Rann, which the author calls 'great gulf' and 'small gulf' of the Eirinon, were holding water, albeit shallow and not fit for navigation. That was the position that prevailed in the 1st century CE. Shortly, we will see that the recent scientific studies vindicate what was seen by the author of the Periplus. Further, in this regard, we can make a little diversion to presume that the Rann was navigable for smaller crafts. On the premise that the same author has made similar observation in respect of the GoK('the gulf of Baraca', i.e. Dwarka). But, we know that GoK has been navigable throughout the historical times down to the present-day. The author of the *Periplus* was possibly thinking of the large vessels used for a heavy volume of cargo of international trading that is why no port is mentioned by him between Barbaricum in the Indus delta and Barygaza (anc. Bhrigukachchh/Bharakachchh,

mod. Bharuch) whereas there were several smaller ports during the historical times and until recently. On the that analogy, concerning the gulfs, it may be surmised that the Rann may have been navigable, at least for country boats, even during the 1st century CE, and was not as bleak and stark as it is today. Schoff, in its annotated notes, has written that the Rann (140 miles 224 km long, and reaching 60 miles 96 km from shore to shore) was "…..certainly at one time flooded by the sea, as shown by the abundance of salt and by the remains of vessels dug up near the neighbouring villages and adds that old harbour works are observed near Nagar Parkar, on the eastern side of the Rann and hence within historical times it was probably the scene of an active sea-trade." (Schoff 1974: 173). It is pertinent to record a tradition that the ships of the renowned merchant and philanthropist Jagdu Sha caring gold and provisions are said to be sailing from port to port in the Rann. Writing in his memories (1827-28), Alexander Burnes records an old story of a shipwreck on Pachham bet and the mariners taking shelter in the island of Khadir.

However, whether under water or dry, it is always 'crossable on foot, in carts, or riding a camel, a horse or an ass' through several routes which have been trodden upon by the human for centuries. It is but natural to hold that the Harappans entered Kachchh and went across to Saurashtra and Gujarat mainland through those land routes, contrary to the theory that they travelled by sea along the coastline down the Indus delta. It was based on a debatable premise that the Rann was then marshy and difficult to cross. The third view holds that the Rann should have been an arm of the sea navigable, although by small vessels, during the Indus times. It is a vital issue for understanding the strong presence of the Harappans in the harsh environment of Kachchh. Furthermore, the location of a large Harappan city of Dholavira in the isolated island in the Rann remains more inexplicable unless the Rann is understood better. In the light of above, an overview of recent scientific studies would be worthwhile.

Here, concern is to know about the basin floor of the Rann and the status of sea level which prevailed when the protohistoric cultures in Kachchh started evolving, attaining culmination and finally disintegrating during the 3rd – 2nd

millennia BCE, and, perhaps, even earlier when the process was taking roots in late 4th millennium BCE. The problem is academic. Earlier observations in connection with the Rann have, by and large, been confined to general morphological description even though it was always guesstimated by all that its basin housed an enormous volume of sediments of Holocene, with a strong probability of the process of building up going back to late Pleistocene. Some useful investigations have since been carried out.

On the basis of 'the description given by earlier workers' in the field of geology, Merh and Patel (1988: 377-391; Merh 1995: 157-161) have shown that the GRK was caused by three east-west trending 'master faults' and the LRK is due to the Bela-Wagad fault, and the sediments deposited in them represent 'filled up gulfs' in an estuarine delta environment that was marked by fluctuating strandline during last 10,000 years when it was influenced by 'glacio-eustasy and seismicity- related tectonism'. Useful information, contained in a table (Merh 1995: 160), mostly drawn from Gupta's studies (1975: 163-175), shows that the LRK is filled up with 62 m of sediments: 45-50 m of that are pre-4000 BCE (*all conversions herein from BP are mine*), hence out of relevance for the present; but significant are 2 to 12 m of deposits which got accumulated in the basin after the said 4000 BCE. Up to 9 m of the latter are of marine origin attributed to the Flandrian (Holocene) high sea that transgressed the Rann from 4000 BCE to 1000 to 2000 BCE. The first set of sediments of fluvial nature is of pre-Holocene period hence out of relevance in the present context. The phase that followed up to the turn of the Common Era there is found fluvial sediments deposited during low sea level. The situation there after is almost what prevails now. Such a huge pile-up of accumulation in the Rann strongly suggest that the floor was much lower than the present sea level, thereby positing that the entire Rann, or a greater part of it, was a gulf of the Arabian Sea. The Rann is still poorly understood.

In the above context, Gupta's study, supported with radiocarbon dates, (1975: 163-75) needs a little elaboration. His investigation near Surajbari and Kharghoda in LRK has provided a three-fold sediment sequence: the upper two being related to the Holocene hence worthy of consideration. The ultimate one of

the two, composed of silty clay, is dated to 2200 to 500 BCE (after conversion of BP into CE) to while the preceding strata are ascribed to 7000 to 2200 BCE. In support, he has calculated that the LR Khad been receiving sediments at the rate of 1.5 to 3 mm per year and concluded that the Rann was under 4 m deep water around 2000 BP. It implies that around 4000 years ago, when the Indus civilization was disintegrating, the floor of the basin would have been 6 to 12 m (average 9 m) lower, thus positing that it was then the extension of the GoK. He therefore believes that the Rann should have been an arm of the sea even if it maintained its present level.

This has got further support from the recent geomorphological study made again in LRK (Maurya et al. 2009: 69-80). According to it, the Rann surface, near its mouth, meeting the GoK, measures 2 m msl which gradually rises to 6 m toward the east and north-east; the entire area is divisible into three, viz. outer, central and inner, sub-basins, demarcated by two separate E-W trending linear series of islands; these sub-basins are progressively higher from each other, and thus would have been shallow, shallower and shallowest respectively in that order in the past. More significant is the find of the presence of wave-cut cliffs running for several kilometres along the straight and rocky southern margin of the two of the islands of the outer sub-basin. These wave-cut notches are attributed to wave erosion when the Rann was submerged under a shallow 'wave dominated sea' during Holocene' when the sea level was higher as shown by Hashmi et al. In contrast, the absence of such wave cut cliffs further northwards suggests that the central and inner sub basins were a 'quite' type of sea.

In all these investigations Gupta's study in LRK and Hashmi et al. these about the Holocene have been heavily relied on by all workers. A recent field investigation (Chowksey et al. 2010: 467-90) on the islands of Khadir, Bela and Bhanjada have exhibited significant evidences of depositional as well as erosional episodes related to the Holocene sea that was claimed to be present there up to 2000 years BP. The first episode is represented by 'a thin linear zone of raised discontinuous flat depositional surfaces of Holocene marine deposit' which, at most places, gradually merge with the Rann surface from which these 'rise up to a height of 4 to 6 m above the Rann on the landward side'. These are

said to be deposited in a shallow sea which existed during C. 6000 to 2000 before present and then receded. At the northwestern extremity of Khadir and the eastern part of Bhanjada, which face each other, there are 5 to 6 m thick sediments of the raised depositional surface showing a vertical cliff. Its terraced surfaces show a general southward slope. In Khadir, it exhibits a gradual reduction in height. These are examined as intertidal deposits which overlie the Mesozoic rocks in Khadir and the intrusive rocks in Bhanjada. Their present status is attributed to a case of two successive phases of uplift. And, the erosional one is characterized by the wave cut notches, platforms and sea caves above the base of the north-facing escarpments that abruptly rise above the Rann, which, in turn, has an average elevation of 5 m msl. Significantly, the lower notch is seen at a height of 2 m and the upper at 4 m above the Rann surface, while the platforms are developed on Mesozoic rock cliff 4 m above the Rann surface. Besides, sea caves of various dimensions are also observed. The authors have attributed both the episodes, depositional and erosional, to the Holocene sea which was present in the Rann during the time from 6000 to 2000 BP (per se c. 4000 BCE to the turn of the Common Era) in respect of the former to two phases of rapid uplift amounting to 6 m during the last two thousand years,

Another study (Maurya et al. 208:746-58),conducted along the Arabian Coast from Narayan Sarovar on the Kori creek to Surajbari at the mouth of the Gulf of Kachchh, has provided complementary information that the mid-Holocene (c. 4000 BCE to the turn of Common Era or thereabout) sea has caused ‘ the deposition of coastal sediments, fluvial terraces along incised fluvial valleys, and formation of cliffy coast in the Narayan Sarovar-Jakhau segments’ while the, “Emergent coastal features consisting of raised beaches, raised mudflats, abandoned coastal cliffs, uplifted estuarine to fluvial terraces, and stabilised coastal dunes developed because of uplift during the last 2 ka”, which also caused drying up of the Little Rann.

It was the time when the Flandrian transgression of the sea of the late Pleistocene or early Holocene was gradually receding albeit with recurrent fluctuations. Of course, Gupta has made a remarkable investigation. So far as the Little Rann is concerned, but it cannot be applied as such to the Great one which

is much broad, long and deep hence accounting for rate of sedimentation. Yet, there is no denying the fact that it did have accumulated an enormous amount of sediments since 5000 year ago when Kachchh was being populated.

In this regard, it must also be borne in mind that Kachchh is a highly sensitive seismic zone (zone V). Structurally, it is a week area under tension and compression. In the recorded memory, it has witnessed more than seventy-five tremors of varying intensity. Particularly, the earthquakes occurring in 1819, 1845, 1892, 1903, 1940, 1945 and 1964 have proved to be disastrous. Some of them have brought about drastic geomorphological and topographical changes. The 1819 earthquake, in particular, destroyed the major towns and villages in Kachchh and caused a series of changes in geomorphology.

In the northwest, the 80 km long elevation of Allah Bund which is 4.5 m in the west and 50 cm near the Kuar Bet close to Pachchham was thrown up; a large portion of the Rann to the north of Lakhpat subsided; the Banni grassland came under the sheet of water; the Indus cut a channel through its delta and reached the sea at the western extremity of Kachchh and watered the low ground north of Lakhpat; for a long distance the northern part of the Rann registered a general uplift; and the southern underwent corresponding subsidence. Also, other changes came about in its wake.

The Nara, the eastern offshoot of the Indus (which was known to the early Arab geographers and historians as the Mihran and, which was probably flowing into the palaeo-channel of the 'lost' Sarasvati in Sind and reaching the sea through the Kori Creek, as the cartographic geo-hydrological maps as well as satellite imageries bear testimony to it) changed its courses to the west. In earlier times, it might be flowing into the Rann filling the latter with the sweet fresh water as well.

Obviously, during the past five thousand years, the landscape should have undergone several changes caused by tectonic activities and a resultant geographical force in addition to normal natural factors causing progressive siltation in the Rann. Numerous seasonal streams, large and small, flowing from the surrounding Kachchh, Sind Rajasthan, Gujarat and Saurashtra must be

depositing every year an enormous amount of earth and sand into the Ranns and the Gulf. Wind action too must be at play for the acts of adding and eroding. It may be stated here that the neo-tectonic activity has caused (and is still at work for) the northward tilting of the Saurashtra peninsula which might had pushed up the sediments of the Rann at least partially, if not over a large area.

Now, we may turn to the maritime role or potential of the Rann. Tradition has it that it was once an extension of the Arabian Sea and was utilized for maritime trade through its various ports perched along both of its banks- the southern and the northern. The ships of the renowned merchant and philanthropist Jagdu Sha, carrying gold and miscellaneous provisions, are said to be sailing from port to port in the Rann. Writing in his memoirs (c. 1827 – 28), Alexander Burnes records an old story of a shipwreck on Pachchham (i.e. Khavda) and the travellers taking shelter in the island of Khadir.

Against this background, it is not unlikely that there was a navigable sheet of water or deep meandering channels, as we find in the Gulf, and the Harappans made full use of them by avoiding trafficking on the Arabian Sea, which is very turbulent and rough in Kachchh and Saurashtra. In contrast to the placid waters of the Rann should have been gainfully preferred. Probably, for that reason, we find ancient settlements of mature phase of the civilization being perched on the shores of the Rann, the Gulf and the Kori Creek, and none so far on the Arabian Sea coast. In the same scenario may be seen Dholavira in Khadir surrounded by the Rann. Otherwise, the location of a city of enormous dimensions such as Dholavira should remain a big riddle.

So far the change during the later days in the settlement pattern, now involving the coastline is concerned, it remains to be seen whether it was related to any change in the character of the Rann or to a change in the lifestyle during the later times when there was a general decline of the civilization which almost a universal phenomenon at all the Harappan sites which have been investigated so

far. It appears that there existed, during the Rgvedic times, a vast water body called Rasa[3] that was attached to the sea.

Obviously with the Arabian sea; and that was not very easy to cross as is conspicuously evident when the Panis were surprised to see Indra's emissary, Saramā, in their land and asked her as to how she crossed the waters of the Rasa. No wonder, Rasa was the name of that Rann which was always full of waters, i.e. the (life-giving) fluid, and was difficult to cross without rowing hence the unpleasant surprise on the part of the Paṇis. Further, it appears that part which was variable, subject to alternate flooding and drying, was called Iriṇa. That is why a kind of salt obtained from Irina was called *airiṇa*. [*Kalpadrumakośa,* 183, 153, Gaekwad Oriental Series Ed.]Salt should have another trade item of the Harappans in Kachchh.

Thus the resolution of the enigmatic location of Dholavira largely hinges on a mult-displinary study of the Rann, which remains a closed book containing in it a long history of character and conditions of climate, sea level and landscape and the recurrent episodes of earthquakes. It may also resolve the relationship that might have connected the Little Rann, the Nal-Bhal depression and the Gulf of Cambay; after all, it involves the problem of Lothal and reaching out to timber-rich, mineral-rich eastern hills of Gujarat as those should have been the prized commodity in the Indus plains as well as Mesopotamia. The Harappan was indeed the mighty exploiters of all possible resources available at home nearer home or from faraway places. A lot more is known about the imperishables. However, imperishables like wood, plants herbs unguents, honey, gums, salt, which Kachchh must have offered are not easy to establish.

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3 (RV.X.121.4:*yasyeme himavaṅto mahitvā yasya samudraṁ rasayā sahāhuh. yasemeh pradiśo yasya bāhūh*) - it purports to announce that all the directions are the arms of the Supreme Being, ('Ka') and that the Himalayas glorify It and its ocean along with Rasā-these appear to delimit the geographical territory of the contemporary peoples.

IX.41.6: *sarā raseva viṣṭapaṁ* - Rasā going round *viṣṭapa* which may mean the universe, the sun, or the world in general (Bhargava: 1964:44).

IV.43.6: *siṅdhurha vām rasayā siňchadaśvan* – here, Rasā is associated with the Indus.

X.108.1, 2, 7: *kathaṁ rasāyā atarah payaṅsi (1), etc.*

2.9 Climate

Kachchh sits on the western margin of the belt of the summer monsoon. As such, it is not an unusual phenomenon that flocks of variegated clouds come floating tantalizingly and drifts away hopelessly without raining for want of natural barriers which can stop them and cause precipitation. It is only when the clouds become dense and heavy the rain pours in torrents and the ephemeral channels start overflowing their banks and sometimes burst through the dams that are built across to store the water. Such downpours, which are rarely more than three in a season, are extremely useful for the crops and the grasses provided those are evenly distributed from July through September, instead of falling in a quick succession any time during the season.

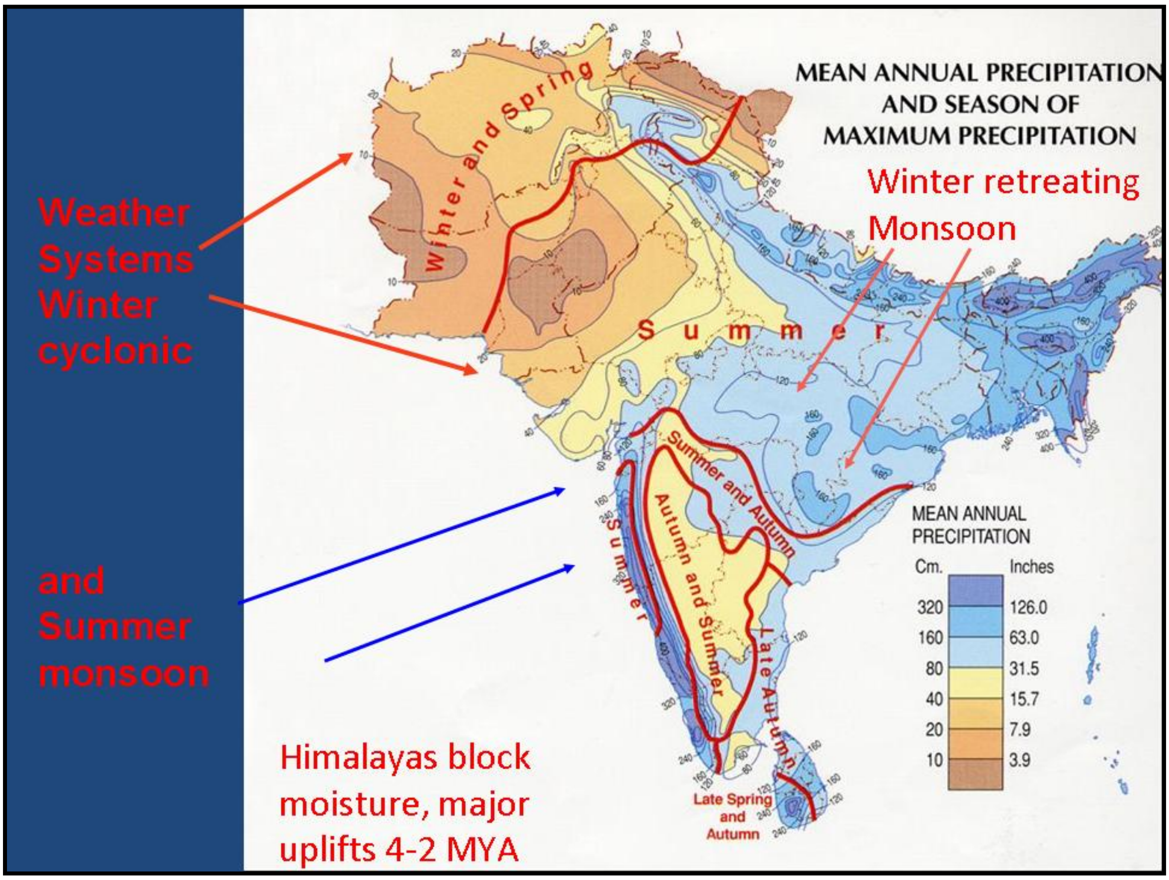


Fig. 2.9: Range of annual and maximum precipitation

Arid Kachchh has little natural bounties for agrarian societies to settle. Environment is rather harsh and uninviting and yet, Bronze Age people came here around the turn of the third millennium BCE and contributed progressively through successive stages of development to the phenomenal Harappan

civilization which lived its full life until it started to decline as everywhere in *Harappania*. It was followed by an interesting phase of cultural transformation which witnessed intense commingling of different peoples and their presence is best reflected by the presence of the potteries belonging to the Jhukar, the Bara, the black & red ware genres in an otherwise continuing in the milieu of the mature Harappan, albeit with perceptible changes in planning, architecture, seals, in a situation in which some urban traits and industrial activities still continue. Lastly, a stage comes when all urban elements disappears the people were living in circular huts. All cultural changes covering about fifteen hundred year from the 3rd millennium BCE have been duly found from the Dholavira excavation.

Dholavira has provided seven stages of the culture which has shown a continuous growth from Stage I through Stage VII, of course the last two stages being preceded by spells of desertion of apparently varying time-lengths. Obviously, there are still missing gaps in the cultural sequence of Kachchh, which can easily be filled by careful study of the excavated and explored materials.

Archaeological scenario shows that Kachchh has been a ‘vibrant’ and ‘density area’. The protohistoric sites, the majority of which are related to the classical phase of the culture, are evenly distributed all over the central Kachchh, and including the islands of Khadir, Pachchham Bela, and Chorar but strangely enough the coastal area of the Arabian Sea has yet to reveal any mature Harappan sites. Why, while the Harappans are known to be the maritime merchants as well?

Why had Harappans occupied the arid Kachchh which is so miserly in nature’s bounties? The rainfall is meagre and erratic; the groundwater is generally brackish and saline; the forest cover is extremely poor; agricultural land is available in patches; the extensive saline mud flat of the Rann is forbidding; and natural resources are scanty. What were the incentives then?

If the coastal area of the sea is devoid of the Harappan sites then why are there so many Harappan sites along the Rann and the Gulf of Kachchh on this side of the land as well as the other side of the Gulf right from Dwaraka area to Halvad? Already eleven sites have been found along the Gulf and the Rann in

Saurashtra. It needs to be examined as to what role was played by the Nal-Bhal depression which connects the Little Rann to Gulf of Khambhat. In the whole the scenario role of the Rann needs a thorough investigation in relation to sedimentation, sea level changes and neo-tectonism. Excavations have shown the bead industry, shell working and stone cutting were flourishing industries. Prospecting of natural resources from near and far, their marketing and transportation as well as making finished products should make an interesting study.

The most interesting part of Dholavira excavation that the Harappan society had a gradual growth but there were some episodes marked by the change of guards who in their turn brought about some changes of far-reaching importance. Last although not the least, the sepulchral monuments and their contents make a marked contrast with the then prevailing system in the riparian plains on the one hand, and suggest different socio-religious make-up of the society that were living in Kachchh.

It should be relevant to add that the western parts of the north Gujarat plain although which is virtually dotted with Harappa-related sites, thanks to the archaeologists of the MS. University of Baroda, was not a lived-in area. It was rather a vast pastureland for the Harappan pastoralists living in Kachchh from where they were making seasonal forays, continually staying from camp to camp near some interdunal lakes.

Thus, Kachchh did have to offer some useful materials like shells, agates, chosen rocks and minerals, and surely some perishables, but those were not, most plausibly, enough for fully meeting the increasing demands of the domestic and international markets spreading far and wide in the riverine plains which were dismally lacking in the requisite metals, minerals and timber. It is therefore desirable to look beyond towards the other parts of Gujarat and also towards the adjoining Rajasthan. The latter is far richer in metals and minerals. Archaeologically speaking, both the states were more or less occupied by the protohistoric peoples, cognate or different within themselves. The northern Rajasthan in its Ghaggar-Hakra plains is already well known for the cultures of

the Indus tradition. In recent years, the southern part has also brought to light the cultures going back to the 4th -3rd millennium BCE. Gujarat is already widely well known for the Indus and contemporary local cultures.

Saurastra and the Gujarat mainland are two other distinct geomorphic units developed on two different palaeo-rift basins. Saurastra is a rocky tableland fringed by coastal plains. Its geological history begins with the sandstone formations of lower Cretaceous period, followed by the Deccan lava flows which cover the major part of the tableland. After lateritic episode, there is a gap, which was broken by the Miocene sediments followed by a continuous sequence to the present. The agate conglomerate deposits in the peninsula were released during the lower Pleistocene age. The black cotton soil developed from the basaltic rocks is fertile and suitable for cotton cultivation.

Physiographically, the undulating tableland rises to varying heights ranging from 300 to 600 and is interspersed with the hills of Girnar-Goraknath (1117 m), Barda-Venus (637 m), Alech (298 m), Osham (314 m) and Chotila (340 m). The peninsula has a radial pattern of drainage, terminally passing through the coastal plain or the Nal-Bhal depression which was once, in the past, possibly around mid-Holocene, under seawater interconnecting GoK and LRK to the Gulf of Khambhat.

2.10 Natural resources

The great urban civilization that the Harappans were naturally required enormous amount of natural resources of diverse kinds. Much of the sources, existing in the north-west of the subcontinent, were well known for centuries or millennia to the peoples gradually from the early farming days and are therefore well researched and discussed. The role of Gujarat and Rajasthan as new providers was always presumed. With the extension of the Harappan civilization and find of newer protohistoric cultures in these parts of the subcontinent makes is necessary to have a look again. Many scholars have discussed one or the other aspect of resources, particularly centring round the metals (Roy 1942: 226-284; Agrawal 1971; Agrawala 1984: 157-162; Chakrabarti 1986: 65-72; Chakrabarti & Lahiri 1996; Rao 1987:383-398; Gopal 1987: 356-365 and others).

Kuppuram's (1989) voluminous work presents a comprehensive study. Of late, Law has made a fresh survey keeping in mind sources and kinds of metals and minerals used by the protohistoric peoples. Not only metals mineral and rocks, the ancient peoples must have as well exploited flora and fauna which were important constituents of the natural environment that prevailed around them.

2.11 Vegetation

South Gujarat owing to better water regime is home to some valuable timber besides many others. Some such timber grows in wetter part of Saurastra as well. In addition, there are a variety of trees providing fruits, flowers, firewood, edible gums, sweet-smelling, gum resins and medicinal plants which are distributed more or less in different parts of Gujarat and Rajasthan. The great diversity in species and their distribution is due to variations in rainfall, altitude, soil, temperature etc. This aspect has been covered in numerous publications, particularly in the Imperial Gazetteer, State (district) gazetteers and books on economic aspect of flora and fauna.

The important timber trees of much economic value are: Teak, rosewood, *tiwas* (*Ougenia oojeinenis*); *şadara* (*terminalia tomentosa*), *babul*, *khair*, *kikar*, to which may be added bamboo; the fruit include mango, zizyphus, wood-apple, custard-apple, jambo */ jamun*, *bel,* oil seeds are; castor, *mahua, karanj, limda, pilu* and many others; the important medicinal trees and plants are: *ashwagandha* (*Withania radia/somnifera*), myrobalan, belleric myrobalan, emblic myrobalan, the gum-yielding trees*kandaya, gugal, gugali, bawal*and many other desert trees and plants. In historical times the gum of gugal and its sub-species well exported for their sweet-smelling quality was used for frankincense and making perfumes while also used for certain ailments. Thus, it can be observed that a wide variety of trees are found.[4]

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[4] Timber trees: Teak (*Tectona grandis*); rosewood (*sisam*, *Dalbergia latifolia*); *tiwas* (*Ougenia oojeinenis*); *şadara* (*terminalia tomentosa*); *babul* (*Acacia arabica*); *khair* (*Acacia catechu*); *kikar* (*Acacia ferrugina*); *jamba* (*Xylia dolabriformis*), a hard and durable wood, sometimes called iron-wood; *haldu* (*Adina cordifolia*); *kalam* (*Mitragyna parvifolia*);

The other trees: *biyo* (*Pterocarpus marsupium*); *sewan* (*Gmehna arborea*); *dhaman* (*Grewia Tiliaefolia*); *kakad* (*Garuga pinnate*); *model* (*Lannea comandelica*); *hewar* (*Acacia leucophloea*); *siris* (*Albizzia lebbeck*), and *rohini* (*Soymida febrifuga*);

The Harappans in the riparian plains may have required a huge volume of wood of different kinds for making a wide range of items from building material, furnishing and furniture to carts and boats, from household tools and equipment to what needed for agriculture, and even in weaponry. The Mesopotamian texts mention import of three kinds of timber from Meluhha though it is difficult to identify them from the terms used but it obvious that those must be precious and useful timber. If Meluhha were Harappania, it may be any three like teak, rosewood, cedar, or some such durable and fine-textured wood. Importantly, charcoal specimens of *teak* (*Tectona grandis*)*, haldu* (*Adina cordifolia*)*,siris* (*Albizzia lebbeck*), and *rohini* (*Soymida febrifuga*)and acacia species have been reported from Lothal (Rao et al.1985: 667-83). The *Gugal and gugali* grow in abundance in Gujarat and Rajasthan and were items of export during the 1st century CE (Periplus) as these were highly valued for their fragrance and medicinal properties. Similarly, gums or various trees have many uses as food items as well as in preparing dyestuff and sealing wax.

Among agricultural produce, which have already been enumerated in connection with Khadir, cotton may be added for which the black basaltic soils in Saurastra, south Gujarat and certain parts of Kachchh are immensely useful and highly valued during the Harappan times. It is a general belief that India is the home of cotton wool and also that the Harappans might be exporting the textiles made from it. It may also be recalled that the cotton thread was being used for stringing copper beads as far back 7th - 6th millennium BCE at Mehrgarh where early farmers had yet to learn to make pottery.

Fruit trees: mango, zizyphus, wood-apple (*kaithFeronia limonia),* custard-apple, (*Annona squamosal*);jambo *(jamunSyzygium cumini);* bel (*Aegle marmelos*); castor plants (*arandi, Calophyllum inophyllum);*

Medicinal trees and plants: *ashwagandha* (*Withania radia/somnifera*); *kidamari* (*Aristolochia bracteata*); *awal* (*Cassia auticulata*); *dhatura* (*Datura innoxa*); *utarni* (*Daemia extensa*); *kali shankhavali* (*Evolvulas alsinoides*); myrobalan (*harad*, *Terminalia chebula*); belleric myrobalan (*baheda*, *Terminalia belliricia*); emblic myrobalan **(***amla***,** *Phyllanthusemblica);kudi* (*Holarrhena antidysenterica*); mararsinghi (*Helicteres isora*);

Oil-seed trees: *mahua* (*Madhuca indica*); *karanj* (*Derris indica/Pongamia glabra*); *limda* (*Azadirachta indica*), and *pilu* (*Salvadora oleoides*);

Gum-yielding trees:*kandaya* (*Sterculina urens*), *gugal* (*Boswellia serrate*), *gugali* (*Commiphora mukul*);*bawal* (*Aracia nilotica*)].

2.12 Animals

The wild animal species include the famous Asiatic lion of the Gir forest, the wild ass (onager) of the Rann, tiger of south Gujarat forest and a number of general ones like panther, jungle cat, deer and ungulates—*sambar* (*Cervus unicolor*),*nilgai* (*Boselaphus tragocamelus*),*chital* (*Cervus axis*),*barking-deer* (*Cervulus muntjac*), antelope—; wild hog; hyena; wolf; fox; jackal; wild dog; tortoise; monkey; *langur*-monkey; sloth beer; monitor lizard; lizard; snakes; scorpion; a variety of common birds; migratory and aquatic birds; crocodile; garial; fish in sea, rivers and lakes and others. Important birds are peacock, parrot, pigeon, mina, crow, duck and cranes, which are represented in clay figurines and/or in paintings on pottery of the Harappans.



Fig. 2.10: Cattle of Kachchh Region

Gujarat is also famous for its three breeds of cattle, namely Kachchhi, Gir and Kankrej. In the medieval period, camels, sheep and goats are extensively both by sedentary farmers and nomadic pastorals, in case of the latter donkeys and dogs are usual companions. Kachchh was famed for breeding horses and camels. Buffalos are reared for milk and traction.



Fig. 2.11: An example of traditional cart vehicle

2.13 Minerals and metals

Metallic minerals are widely distributed in Rajasthan and in certain localities in Gujarat. While the northern part of Aravallis is phenomenally rich in copper, the southern one is in base metals containing lead, zinc and copper.

2.13.1 Copper

Copper was the most multi-purpose metal used by the Harappans. From jewellery to weapons, from utensils to figurines, and from working tools to nails- thus practically for all purposes. Yet, there is no area falling in their domain to provide this metal or its ore. The need would have been tremendous. Rajasthan which has large reserves of copper ores was separated by forbidding expanse of desert. Secondly, the only area that was densely populated before, during and after the Indus period lay far north in the valleys of the Ghaggar and Chautang and the intervening area is broad and long desert full of sand dunes.

Earlier, the protohistoric culture found in the Banas valley in Rajasthan was deemed to be post-Indus or late contemporary. Now that the antiquity of the culture flourishing there has been push back, and a large number of Copper Age sites. Known after Ganeshwar in the northern part of Rajasthan, the attention of

the archaeologist has been drawn to this area as a probable source of copper and some other metals. The strong presence of the Harappans in the dry and harsh Kachchh heightens the importance of the promised land of Rajasthan and Gujarat from this as well as other angles. The metal-bearing areas of both the states are well documented by geologists and others who have studied or sited a large number of workings.

Occurrences of copper ore are present in as many as eighteen districts, extending right across the Aravallis, from the extreme south-west in the districts of Sirohi, Dungarpur and Banswara to those of Churu, Jhunjhunu and Alwar in the north and north-east, and the remaining fall continually between the two. The northern part which is phenomenally rich shows extensive ancient workings spread over in six districts. In particular, the Khatri belt in District Jhunjhunu and the Alwar belt in the district of the same name.

The ancient workings are noticed in the form of heaps of slag, broken furnaces, posture and quarry-pits close by or at distance. Since lot of water is required in the process of ore-dressing there in found in many cases provision of storing water in pits, tanks or even quarry-pits. There are cases where regular wells were built. Bawan-kui and Sat-kui, literally meaning a place having 52 wells or seven wells, echoed in the name itself.

Tarika Oberoi has compiled the data in details of metal-bearing sites and tabulated the same (1996: 49-51, 74-81). She has also presented picture of the cultural scenario of the past (ibid.: 112-192). All these areas have yielded protohistoric sites of Ahar and cognate culture in the southern and Ganeshwar culture in the northern part of the Rajasthan.

Gujarat has not yielded any such copper ore-bearing sites. Although there are mineralized zones of base metal containing copper as one of the constituents along with lead and zinc with a little percentage of gold and silver.

2.13.2 Base metals

The Districts of Banaskantha and Vadodara in Gujarat, Udaipur, Bhilwara, Bhratpur and Pali in Rajasthan have yielded mineralized zones of base metals.

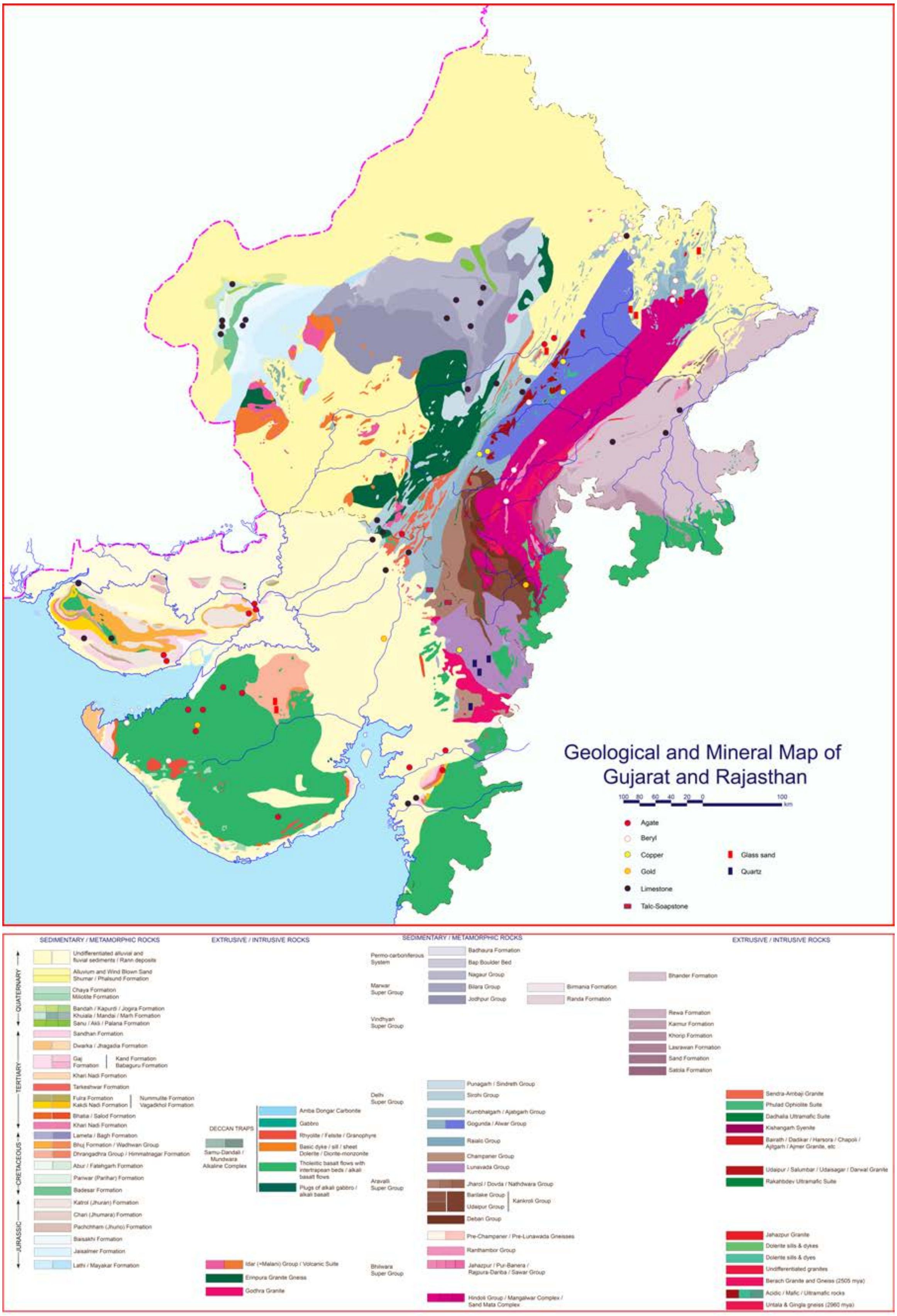


Fig. 2.12: Geological and Mineral Map of Gujarat and Rajasthan

These are the largest and richest in India. Ancient workings found at many sites evidence that the most of them were being exploited extensively and regularly from the 10th century. GSI (2001:48-49) has found lead mineralize zone, with the galena occurrences in the Champner rocks in village Khandia in District Vadodara. In District Banaskantha

Amba Mata (Ambaji) area provides occurrence of base metal mineralization in five sub-parallel zones distributed over and area that measures 800 m long and 200 m wide yielding ores in the form of galena, sphalerite, chalcopyrite and pyrite are the primary sulphides occurring in talc schist and biotite-quartz schist. The ore contains 3.3 % lead, 5.3 % zinc and 1.5 % copper. With the aid of modern technology even silver and gold can also be recovered it may not have been possible by the ancient smelters.

Many kilometres long zone at the village Jariba, near Ambaji town, Runsfrom Gujarat into Rajasthan in a cherty quartzite band.

The third area of lead mineralization in Gujarat has been found at the village Khandia (Vadodara District).

Chapter 3

3.1 Dholavira: Ancient Remains and Environs

The ancient site at village Dholavira (23º 53’ 10” N; 70 º 13’ E), Taluka Bhachau, District Kachchh, Gujarat (India), lies in the island of Khadir which, in turn, is surrounded by the salt waste of the Great Rann of Kachchh. Two monsoon channels, namely the Manhar and the Mansar, embrace the ancient settlement. The ancient ruins, including the cemetery, cover an area of more than 70 hectares half of which is appropriated by the articulately fortified Harappan settlement alone. Ever since their discovery, the ancient mounds of Dholavira had aroused great curiosity among archaeologists. After a lapse of almost two decades, there was carried out a systematic survey and documentation of the visible structures and other features of the mound and their environs. It made it obvious that it was, perhaps, the best-planned Harappan city with several divisions and many new features hitherto unknown.

The mounds, (two of them being locally known as ‘Kotada’ and ‘Bazar’ specifically, while the others remaining unnamed), are located less than 1 km northwest of the village. The ancient remains are embraced by two seasonal torrents, namely the Mansar and the Manhar, which emanate from the hills in northeast and flow in their defined beds cut through the motley terrain of rocks and alluvium till they join each other before running into the Great Rann. These are ephemeral streams, which carry a heavy volume of water after downpours in the catchment area but dry up quickly within hours. There is, however, no perennial source of surface water other than the artificial lakes and ponds, which, too, are solely dependent on the monsoon.

However, Dholavira in the entire Khadir is exceptionally blessed with such good groundwater reserve in its soft sedimentary limestone deposits that they did not fail it even during the severest drought that visited the larger parts of Gujarat during the eighties of the last century. The soil is rich and fertile sandy loam although not available plentifully for cultivation as it is largely restricted to a

narrow strip running along the Rann from northwest through south to southeast, or to a few patches in an otherwise rocky terrain intersected by numerous torrents, which originate in the northern hills.

During the field seasons of 1978-88 and nearly twenty years after the discovery of the site, the present author made a thorough study of the ruins and found that many important architectural remains were lying far and wide much beyond the visible mounded surface of the site. Since the extant remains structures were largely made of stone, the architectural elements were fairly intact and more or less visible on the surface. All such remains were carefully studied and plotted with the aid of plane table. As a result there came to light the existence of an excellent example of articulate planning of an Indus city of large proportions and multiple divisions. The location of a large settlement in an isolated island in the desolate region of Kachchha has indeed posed riddle in view of the incongenial natural environment of today.

The proper city complex is fortified by massive defensive walls and furnished with extensive open areas surrounding three principal divisions. On the basis of their relative location, layout and architecture these major divisions were named as citadel, middle town and lower town as mentioned elsewhere. The longer axis of the general fortification is from the east to the west. While the northern arm is about 775 m long, the western one is nearly 620 m. Both of them are fairly traceable for almost the entire length whereas the remaining two are missing in the north-eastern zone obviously due to the vagaries of the nature and man because that area being raised rocky terrain was more vulnerable. However, the southern arm may be seen over a length of 600 m and the eastern one for a short distance of 210 m with some vague indications for another 100 m. IT may be mentioned here that the northeastern zone now stands cut off by the traverse course of the Manhar which runs from the northeast to the southwest.

Inside the fort wall, on all four sides, there are provided wide-open spaces which are subdivided by several cross-walls raised at strategic points determined by the gateways or the corner of the inner fortifications. The large central area

houses three principal divisions of the city of which two, i.e. the Acropolis and the Middle Town, are on the west and third, i.e. the Lower Town in the east. The first two, in their turn, are heavily fortified with intricate defence works while the third does not seems to have any such fortification of its own, although lies well within the general one. The acropolis is located on the south and the middle town on the north and both are separated from each other by a wide-open space. While both have their distinct fortification system, at the same time that system is nicely integrated with ingenuity into each other by way of extending fort walls so as to enwall the open space that separates the two. Gateways are provided through the walls at both ends, i.e. in the east and the west of the open space. For the first two, more particularly for acropolis which houses an imposing castle – possibly the seat of the highest power – the town planners raised a vary ambitious, imaginative, complicated and almost impregnable defence work of great architectural interest and value.

A cemetery area was also noticed to the west-southwest of the city with numerous stone cairns, circles, slabs lying on the surface indicating the location of protohistoric graves. Among these numerous stone circles and cairns were also noticed at least three prominent tumulus or earthen mound rising to at least 2-3 m in height from the surrounding plains and on the fringes of an ancient lake. This ancient lake lies to the southwest of the city and could have been caused by the Dholavira Harappans to hold the surplus water emanating from the city walls, reservoirs, after they were completely filled up. The location of the large tumulus and other cenotaphs to the north and northeast of this lake clearly indicates the preference of the Harappans to locate the cemetery.

3.2 Outlying Features

3.2.1 Quarry Fields

Evidence for quarrying limestone from at least three locations is noticed to the northeast and northwest of the Harappan settlement at Dholavira. The various materials that could have been manufactured include various kinds of

pillar elements, pilasters, door sills, special kind of architectural elements, slabs for water tanks, covering stones for drains, and in one case drain mouth, weights, bowls, etc. One of the quarry fields is locally known as Baral pat, meaning burnt ground, in the local dialect.



Fig. 3.1: Surface remains of the quarry site

The presence of numerous chipped stones spread over a large area indicates large-scale quarrying activities by the Harappans. The prominent find is a large bi-convex unfinished pillar member which was abandoned due to the presence of faulty veins of quartz crystals inside the stone formation. There are numerous other evidences of removal of long slabs of stones. Unfinished pillar members could have been carried from the same site by the late Harappans for probable use near the east agate. Another interesting feature of the site is that except the unfinished pillar elements, large-scale chipping of stones, no other evidence of Harappan presence is noticed. The stones could have been chipped using the primitive stone knapping technique and no evidence of use of copper chisels, as such, is noticed. The chipping of these limestone blocks could have

been carried out using the gabbro nodules, as indicated by an investigative probe carried out by Prakash Sinha, Allahabad University and Sanjay Manjul, Institute of Archaeology.



Fig. 3.2: Details of the quarry site



Fig. 3.3: Large chips and stone flakes

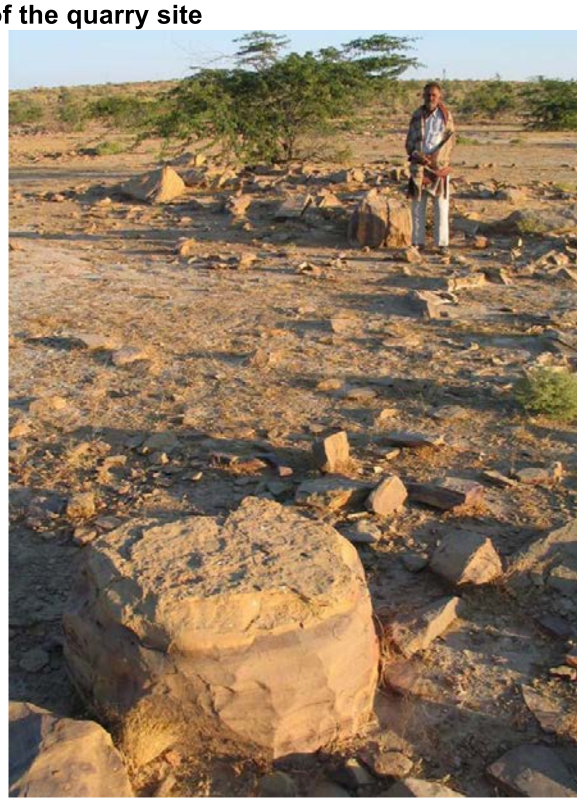


Fig. 3.4: Unfinished stone member



Fig. 3.5: Details of removal of chips



Fig. 3.6: Conchoidal fracture on a large flake



Fig. 3.7: Details of the unfinished stone pillar member

The stone quarry site has been explored by Sanjay Manjul in January, 1995 and he reports that the quarry area is located about two km. in the direction of north-east from the Harappan settlement towards the *Machhi* post. The hillock is locally known as *Varalpat* which means burnt surface. At the site, more than six unfinished stone architectural members have been noticed ,scattered in different

locations within a radius of 500 mt. Dholavira has revealed many architectural members of yellow and banded limestone in different size and shape at east gate, north gate, north gate of bailey and lower town and those are similar to the ones noticed at the quarry site. It was also noticed that those at the quarry were discarded because of inherent defects such as crystallization or some cracks or pocket. It may noted that the limestone formation is sedimentary in nature, geologically, it is of Middle/Upper Jurassic period.

To comprehend the quarry process, a 2x2 m. trial trench was taken up around a stone block which lies on the surface, while excavation we have noticed deposition of earth of about one m. containing many stone flakes/chips. Some of the stone flakes ware also scattered on the surface. On the basis of evidence the following steps of manufacturing were observed:

Step 1

Selection of area: - That there still exist many raised formations and the artisan chose such ones to carved out a desired shape depending on the size of the formations. First they marked the length and width to get the size of what was to be made. After that outer area was excavated almost 1 m. deep by using block on block technique with aid of gabbro pebbles from the nearby Bhajara bet, which are igneous and mush harder. Many similar pebbles have also been found at the site for manufacturing purposes.



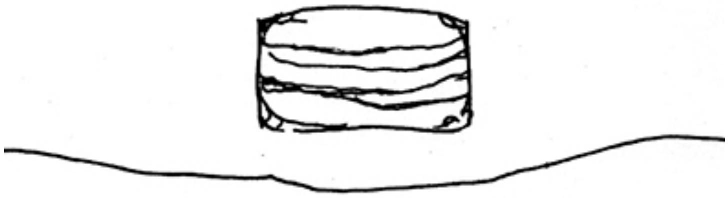
Step 2

After removal of outer part, the block was detached from the parent rock with the help of wooden logs. It is noticed that banded limestone can be detached easily following the line of sedimentation by applying pressure technique on the bands. They had taken advantage of composition of rock in the quarry.



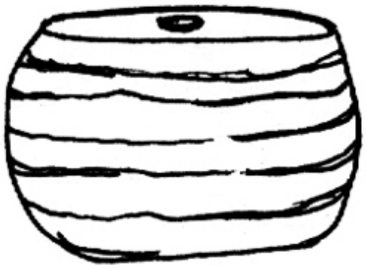
Step 3

The stone block was further shaped by the block on block technique. The striking evidence has been noticed on a semi-finished stone architectural member and stone flakes/chips of same stone are also found scattered all around.



Step 4

The discovery of semi finished architectural members from Dholavira site and discarded members from quarry site indicate that these were brought to the habitational area and the final finishing was carried out by flaking out small chips, rubbing and polishing to get desired shape and size.



It is not very clear whether the final finishing and polishing of this pillar elements and architectural features were carried out at the site or at the city itself. The absence of Harappan materials indicate that the artisans were carrying cooked food and water in leather bags for the day. The quarrying activities were not carried out very deep and the available protrusions were shaped into form and finish.

3.2.2 Karani

Karani is located by the side of the Jhandiasar Nala, well within the revenue jurisdiction of Dholavira. It is an open landscape amidst fields and some undulating rocky terrain. The site is located on the right bank of the Nala and houses a number of round cairns built on a rectangular platform raised. To the northeast of it, there are found two rows of rooms seemingly arranged in an L-shaped layout. At the face of it, those walled rooms appear to have been used by the persons looking after the mortuary functions as well as for the family members of the dead who gathered there to perform the last rites or even subsequent ones, if any. The pottery scatter littered there also suggests that some attendants were stationed there permanently for security of the monuments

which possibly belonged to important person. One thing that is notable about the funerary monuments is that they are made of fine-grained, bright yellow limestone pieces of medium size without using mortar. Only an excavation may reveal the true personality of the site which holds a promise of yielding new evidence.

3.2.3 Ratnasarwali

Ratnasarwali is located by the side of a monsoon channel in the village of Gadhada. The remains at Ratnasarwali consists of a small fortified settlement on the right bank of the torrent, a working / industrial area on the other side across the channel and a cemetery farther away, upstream. The cemetery, among several sepulchral monuments, contains two high platforms, each provided with four to five rectangular sepulchres. On one platform, the individual grave structures follow N-S orientation while on the other the E-W.

3.2.4 Khander

Khander is located to the north of village Janan and has suffered extensive damage due to the intensive cultivation. The surface remains indicated the presence of large number of pottery and bones. The pottery remains indicate the presence of a cemetery of stage III. The stones from the graves have been completely removed and stacked on the sides. The name of the locality is an indication of the ruins once present at this site. Although the surface features have since been erased in toto yet an excavation may brought to light some interesting still buried in the ground.

3.2.5 Saran

Saran, on the shore of the Great Rann of Kachchh, is about 3.5 km. north of Dholavira. This seems to be a small Harappan port catering the needs of the ancient metropolis. The site is located on the left bank of a rivulet. Its water is potable at the source for most of the year. Ancient marine engineers seem to have preferred a narrow creek between a small rocky outcrop and a hill for the jetty. On the flat top of the outcrop are the ruins of a large rectangular building

oriented east-west. This building may have been a warehouse for the temporary storage of goods. In plan, the building has a row of nine small rooms set along its northern wall, which were possibly fronted with large verandas. At the eastern end, the building had three small rooms. These yielded very few potsherds from the Late Urban Harappan assemblage. The extant height of its walls measures 0.53 m. to 0.80 m. with a width measuring 0.70 m. The lateral walls of the building on east and west were extended on the slope to the rivulet below, perhaps to create a large open enclosure. The western wall, traceable up to a length of 18 m. may have terminated at a large platform of approximately 8 sq. m. located right on the bank of the river. The enclosed area also seems to be further partitioned into two divisions by a north-south wall. The platform on the bank of the estuary appears to be meant for loading and unloading cargo.

The building stood at an altitude of 8 m. above MSL. The present bed of the rivulet is about 6 m. below the base of the building and about 1.5 m. above the present surface of the Rann. If it is assumed that the Rann was an extension of the sea and was 4 m. deep during the Harappan era, and the sea-level was 1-2 m. higher than what is today, the 6 m. deep water could have been sufficient to bring the vessels to the platform through the estuary. Further, the estuary may have been preferred as a secure mooring place protected from sea storms. The Harappans of Dholavira may have preferred this location because it was on the shortest route for boats/ship coming from the Gulf/Little Rann side and from Sind in the north across the Great Rann. A location south or west of Dholavira town would have made the journey slightly longer.

Chapter 4

Excavation Strategy and Cuttings

4.1 Aims and objectives

It had become obvious that the site was multipartite and multifaceted, holding a great promise of adding new chapters to the Harappan personality. Accordingly, from the initial years, objectives were set to ascertain and bring out most of the salient features of planning architecture and cultural progression, including funerary monuments and mortuary practices. Some objectives were set for each field season. As usually happens each excavation solves some problems and also throws up new ones warranting a further probe. If all put together the aims and objectives of the excavations were the following:

1. ***to obtain a cultural sequence for each of the division and subdivisions because each one has different thickness of occupational deposit indicating that there lay a different story of beginning, growth and decline;***
2. ***to ascertain or otherwise the existence of each fortification system: general, and those of castle, bailey, middle town and open grounds;***
3. ***to expose some of the gates of different divisions as those were indicated by shallow depressions visible in the continues run of the suspected defences;***
4. ***to determine broad features of inner layout of each part of the city;***
5. ***to understand the nature and function of both open grounds;***
6. ***to find out the precise nature of the visibly partitioned open spaces almost, surrounding the built-up areas of the settlement, as some or many of them could be water tanks owing to the presence of dams across the monsoon channels of the Manhar and Mansar;***
7. ***to confirm likewise the use of those open spaces which were provided within some of the divisions;***
8. ***to investigate some of the funerary structures, including the tumuli, in the western cemetery where much of the Harappan potsherds were notice on the surface, although,***

however, many graves were notice to the north as well as east of the settlement along with the pottery of the historical (Kshatrapa) period;

9. ***lastly, although not the least, to locate some of the quarries from where the Harappan builders obtained stone.***
10. ***It is, however, added that from the field seasons of 1991-92 onwards through 2003-04, baring three ones, were inter alia aimed at imparting training in excavation to the students of the Post-graduate Diploma course of the Institute of Archaeology, ASI, in addition to trainees deputed by some universities and state departments of Archaeology.***

Needless to say that the almost all the objectives were not only successfully realized, but have shown up many a hitherto unknown feathers of cultures which were discovered there, and also yielded a huge amount of antiquities, raw materials samples, many other related problems which will keep a host of scientists engaged in the future.

4.2 Excavation strategy and Cuttings

For excavation and recording, in the first year of excavation, Wheeler's system of grid-plan was adopted. The entire mounded area was divided into four parts, named as 'A', 'X', 'Y', and 'Z' in a clock-wise fashion starting from south-east. The central point was fixed in the middle town area. Excavation and documentation in the first year, i.e. 1989-90 was in accordance with that but It did not work satisfactorily at an extensive site like this. Therefore, a new system, named as GSQ, was devised. One square kilometre of the area bearing antiquarian remains was brought within the GSQ system and divided into 100 grids – each measuring 100 x 100 m; each grid was further divided, into 100 squares of 10 x 10 m each; and each square, as usual, was subdivided into quadrants of 5 x 5 m each. Both grids and squares thus had rows of tens either way. Serial numbers denoted by Arabic numerals ran from north to south starting from the north-east. In case of quadrants, numbering was clock-wise from the north-east. To elucidate, 11 x 20 x 4 represents the 4^{th} quadrant of 20^{th} square of 11^{th} grid.

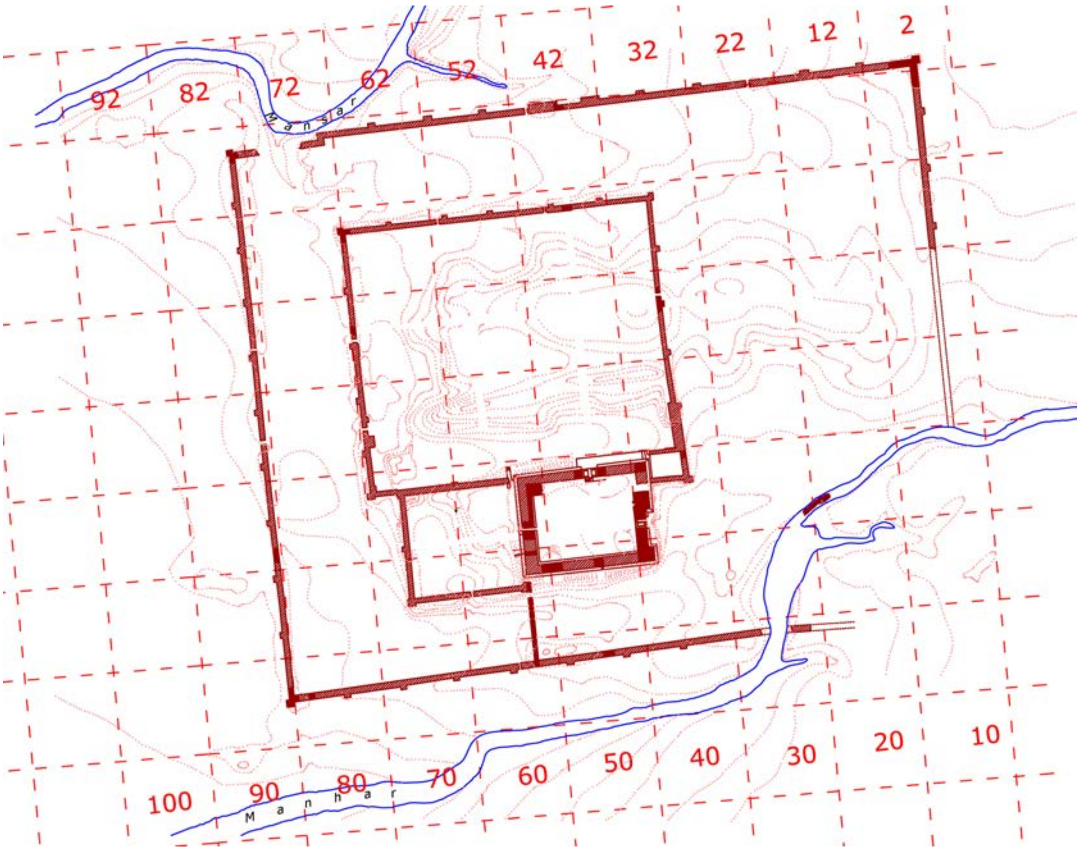


Fig. 4.1: Plan showing the Grids of 100 X 100 m each

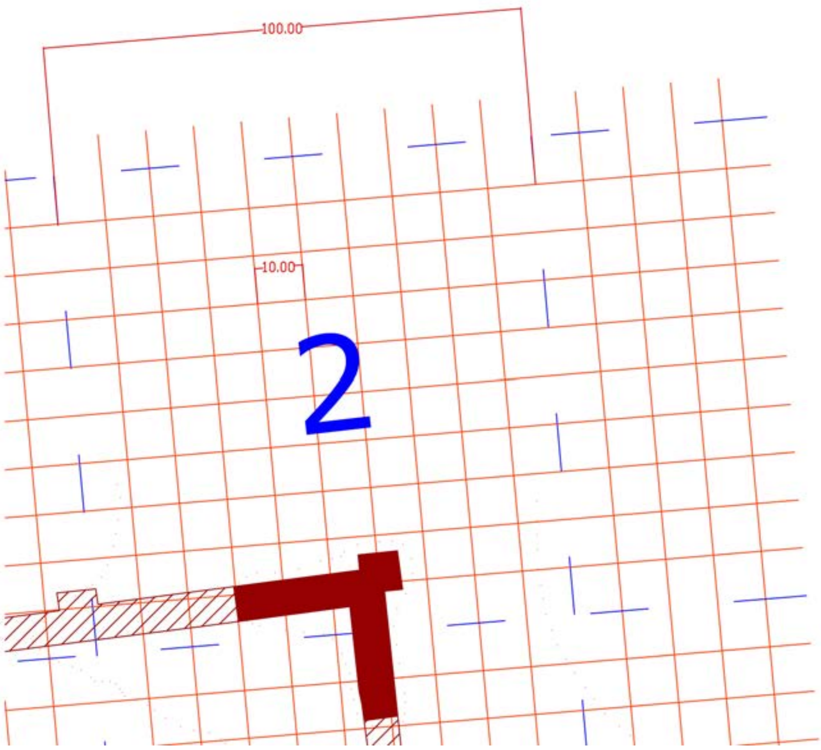


Fig. 4.2: Example of Square of 10 X 10 m each

For excavation, five rows of squares, criss-crossing the entire settlement in a tic-tac-toe fashion in order to cover principle features and divisions, etc., were chosen for excavation. Needless to say, it helped to conjure up an overall picture. The GSQ plan was laid out 4^o to 5^o off the orientation of the visible features of architecture and planning so that minimum number of structures is obstructed by the balks which are left between the quadrants and squares for the purpose of stratigraphical and architectural control. This paid off remarkably. It may be mentioned here that when the north and east gates of the castle had been exposed, it was observed that the firmly fixed basal members of pillars and pilasters provided a positioning of 4.5^0 off in relation to the magnetic north prevailing in January 1991.

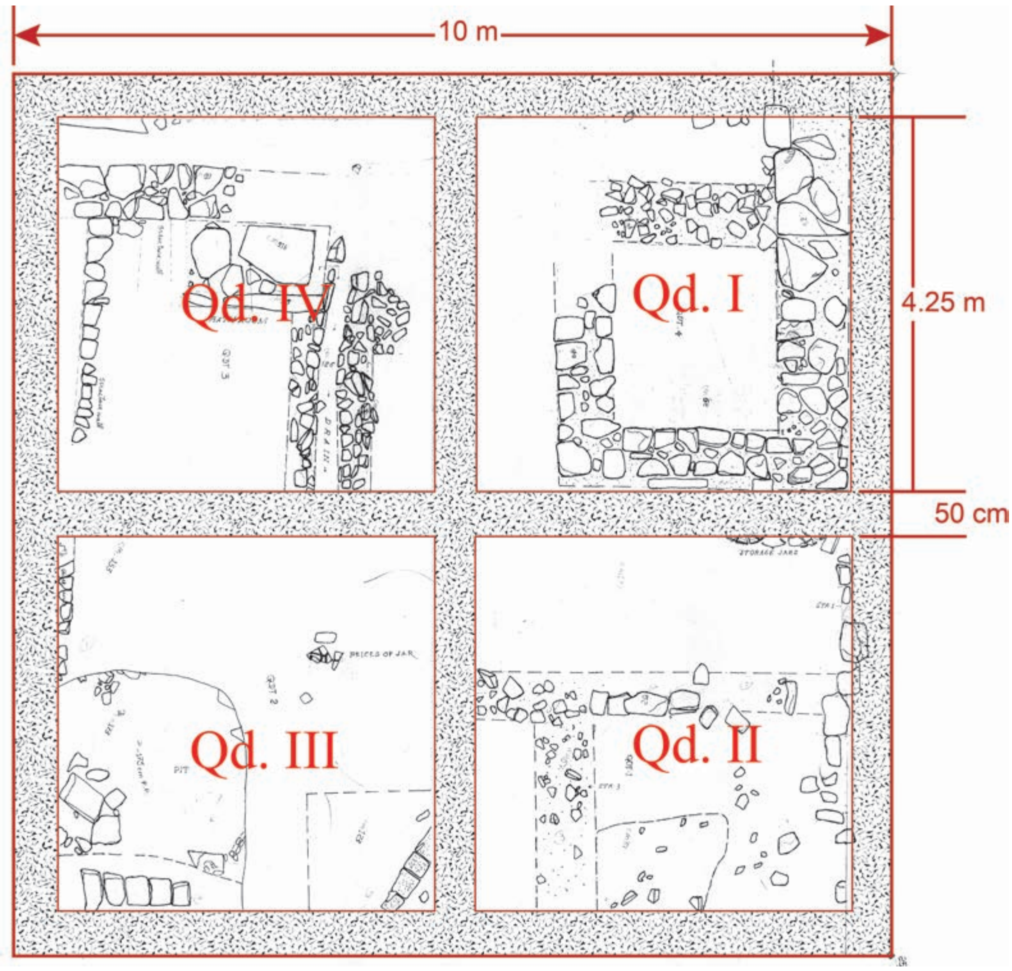


Fig. 4.3: Example of a Grid of 10 X 10 m and Quadrants of 4.25 X 4.25 m each with 50 cm balk all around

Dholavira was excavated for 13 field seasons during the years from 1989-90 to 2004-05, save for 1993-94, 1995-96 and 2000-2001. The first two years of

excavation was conducted by the Excavation branch-V, Vadodara, and then by the Institute of Archaeology till 1996-97. Subsequently, the work was continued by the Directorate General of the Archaeological Survey of India with the assistance from Excavation Branch–V, Vadodara and Vadodara Circle. The excavations were carried out under the direction of the author all through.



Fig. 4.4: A view of trench across rain gully in the Castle, Dholavira

The excavation through an enormous deposit caused by the successive settlements at the site for over 1500 years during all through the 3rd millennium and unto the middle of the 2nd millennium BCE have revealed seven significant cultural stages documenting the rise and fall of the Indus civilization in addition to bringing to light a major, a model city which is remarkable for its exquisite planning, monumental structures, including element of aesthetic architecture, amazing water harvesting system and a variety in funerary architecture. It also enjoys the unique distinction of yielding an inscription made up of ten large-sized signs of the Indus script and, not less in importance, is the other find of a fragment of a large slab engraved with three large signs.



Fig. 4.5: A view of trench across rain gully in the Castle, Dholavira



Fig. 4.6: A view of trench across a rain gully in the Castle, Dholavira

The salient components of the full-grown cityscape consist of a bipartite 'citadel', a 'middle town' and a 'lower town', two multipurpose grounds used as

‘stadiums’ as well, an ‘annexe’, a series of reservoirs, all set within an enormous fortification running on all four sides. Interestingly, inside the city, too, there was an intricate system of fortifications. The city was, perhaps, configured like a large parallelogram boldly. The citadel at Dholavira, unlike its counterparts at Mohenjo-daro, Harappa and Kalibangan, but like that at Banawali, was laid out in the south of the city area, not so away in the west.

Like Kalibangan and Surkotada, it had two conjoined subdivisions, tentatively christened at Dholavira as ‘castle’ and ‘bailey’, located on the east and west respectively, both are fortified ones, the latter one being attached to the former. The former is the most zealously guarded by impregnable defences and aesthetically outlined by massive walls with their longer axis being from the east to west. On the bases of their relative location, planning, defences and architecture, the three principal divisions are designed tentatively as ‘citadel’, ‘middle town’, and ‘lower town’.

Furnished with impressive gates, towers and storm water drainage. To the north of the citadel, a broad and long ground, probably used for multiple purposes such as community gathering on festive or ceremonial occasions, games and a marketing place for exchanging merchandise during trading seasons. Further north, there is laid out the middle town while to its east is founded the lower town.

The middle town and both the grounds are secured within the three common massive fortifications which, like that of the bailey, are in turn, dovetailed is that of citadel. The lower town does not have an appurtenant fortification is however set within the general circumvallation of the city. Besides, to the south of the castle, and the running chain of reservoirs, there lies another built-up area, which rues along the city wall. It is designated as Annexe, meant for housing perhaps warehouse and other specific uses.

The layout that is briefly described above pertained to the fully-developed form of the Harappan city which had attained this culmination in Stage III and the successors of the followed two stages maintained it as such. Dholavira has, however, yielding a convincing account of the successive growth as well as decline of the settlement. The city of Dholavira in its fullest form was a precisely

proportionate whole and proportionality resolved configuration following a resolute set of principles of planning and architecture with mathematical precision and, perhaps, with astronomically established orientation. Of the city, at present, three corners with partially eroded towers but fully intact inner corners have been confirmed by excavation.

When measured between the inner corners, the E- W length of the city area along the northern defensive wall and N-S one along the western one worked out to 771.10 m and 616.87 m, respectively - thus giving the precise ratio of 5 : 4. Similarly, the other divisions of the city also revealed amazing ratios and proportions. The diagonal drawn between the two opposite angles made by the north-eastern and the south-western corners of the city touched the north-western corner of the castle. While of the remaining two, the south-eastern corner is still missing, or not found out, a line, therefore bisecting the north-western angle also bisected the north-western corner of the middle town and further on cut across a crossing of four streets and finally the north-eastern corner of the castle. This could have been achieved by precise mathematical calculations and drawings which were then translated on the ground that was undulating by 13 m in gradient. It was indeed a great engineering achievement. In the whole scheme, the enwalled area of the castle became 49^{th} (7 X 7) part of the city while its total built-up area was 25th (5 X 5) part.

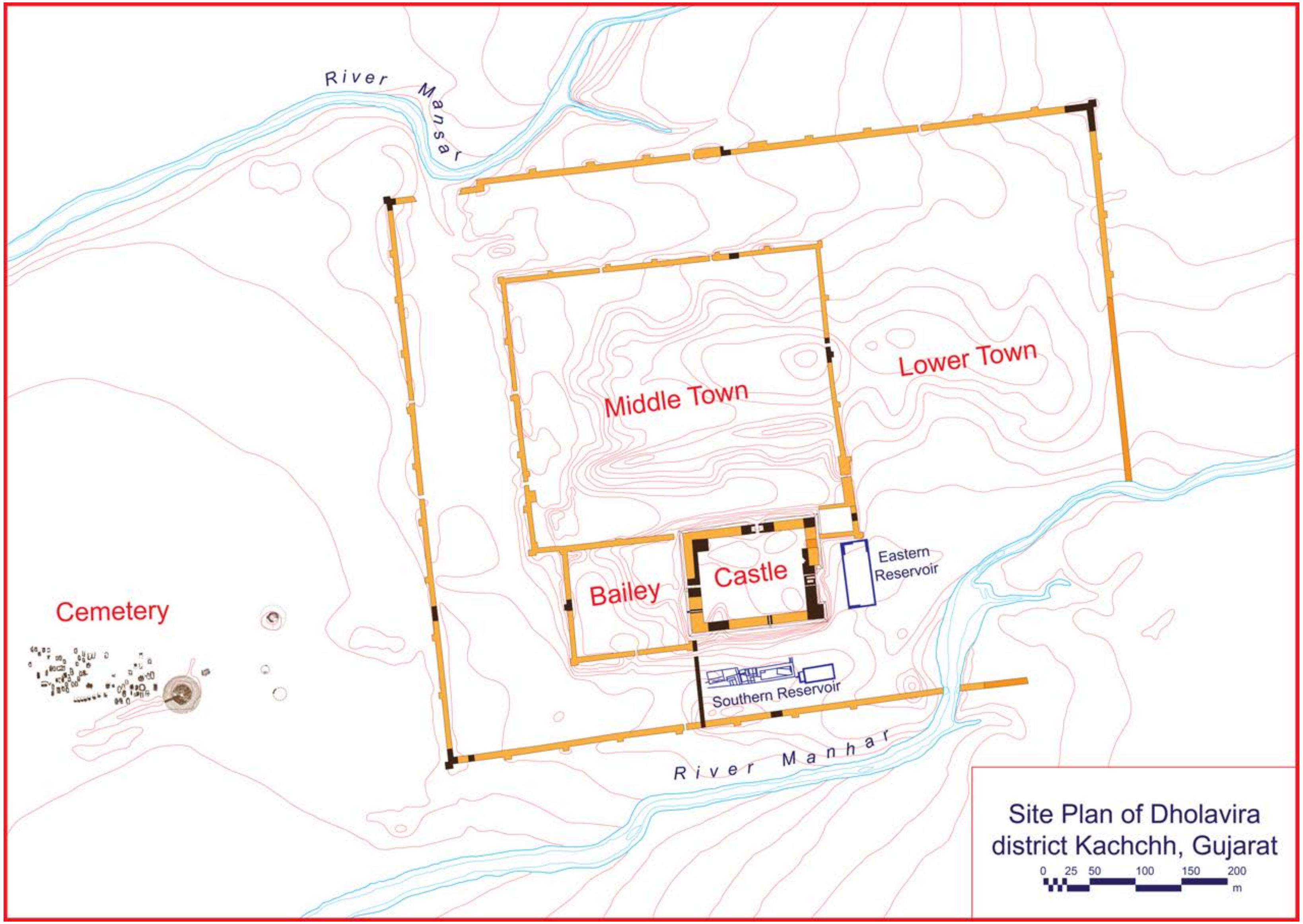


Fig. 4.7: Site plan showng the city planning and layout and prominent divisions of Dholavira

Chapter 5

Summary of Results: Stratigraphy and Chronology

There are identified seven major cultural stages, serially numbered from Stage I to Stage VII which document the gradual rise, culmination and fall of the urban System of the Harappan civilization vis-à-vis the settlement probably over a time period of one and a half millenniums spanning the whole of the 3rd millennium and half of the following. The cultural sequence is best represented in the section cut across the southern arm of the fortifications of the castle near its southwestern corner.

5.1 Stage I

The remains of the first settlement belonging to Stage I lie buried beneath the castle. It was enclosed by a massive fortification wall. A part of its southern arm, running along the east-west axis, was cut across near the southwestern corner. Its basal width measured 11 metres and the extant height of the battered wall was about 6.5 m. The height should have been much more originally, as part of the western arm, exposed within the thickness of the later wall near the western gate of the castle, appeared It perhaps covered a larger area, particularly in the east where remains of a massive wall of identical nature and perhaps orientation too have been found running further eastward, beyond the southeastern corner tower of the later date. The foundation of planning that was laid in Stage I formed the nucleus on which the subsequent settlements of the later stages expanded into a full-fledged city. Even the building materials, whether standardized bricks (9 X 18 X 36 cm, ratio being 1:2:4) or stone, both undressed and dressed, remained almost the same.

The artisans of this stage were fully well-versed in copper working, stone-dressing, bead-making, shell-working and advanced ceramic technology, as well as in planning and architecture. Items like triangular terracotta cakes, perforated, dishes-on-stand, basins and a reserved slip ware pottery, all of which would proliferate in the subsequent stages and become essential items of the Harappan culture, were present in Stage I at Dholavira from the beginning.

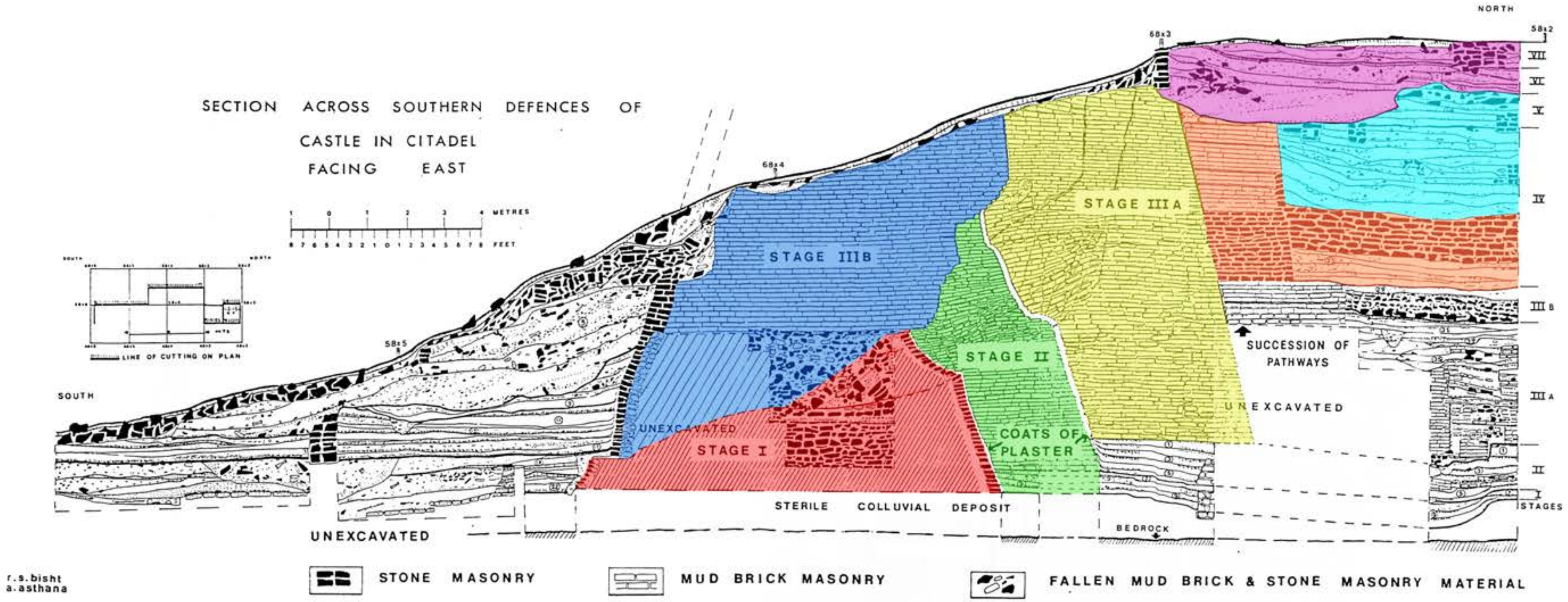


Fig. 5.1: Schematic section across the rain gully of Castle shoing seven cultural stages

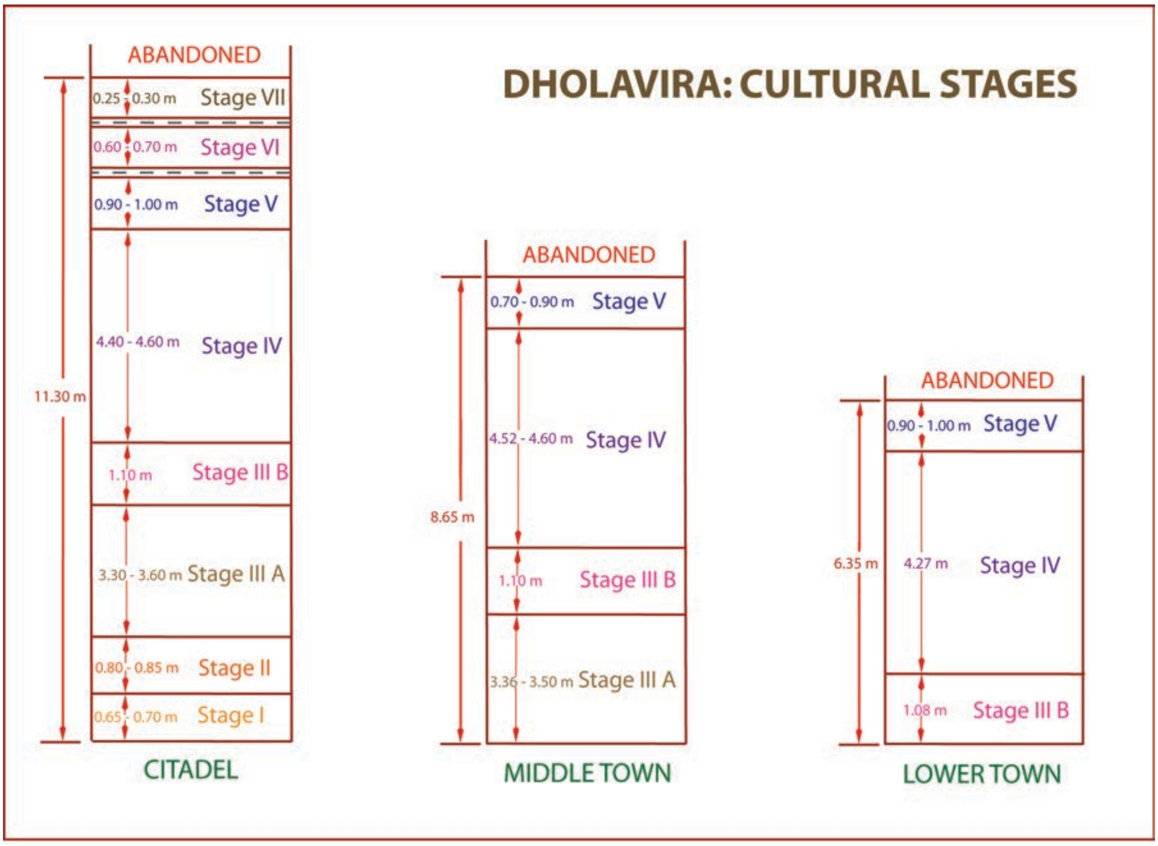


Fig. 5.2: Schematic representation of cultural stages of various divisions

The evidence of copper working during Stage I is indicated by the presence of large quantity of slags with greenish traces indicating the probable smelting process undertaken to purify the ore. It may be interesting to note here that Ambaji mines is not far from Dholavira which is one of the nearest copper ore sources. The cultural deposit of Stage I as evidenced from the excavation at the rain gully across the southern fortification of the Castle is 65 – 60 cm.

5.2 Stage II

In Stage II, a 2.80 m thick brick masonry wall was added to the pre-existing defensive wall from the inner side and the face of it has plastered over with fine paste of white and pink clays, at least, as many as thirteen times. The walled area would have been as large as that of the preceding stage, because the brick masonry addition of this stage was found abutting the wall segment of Stage I that runs outward in the east. There is another significant development that took place. A residential area was coming up to the north of the walled

settlement. Besides, pottery forms and antiquities diversified as well as increased in both quality and quantity.

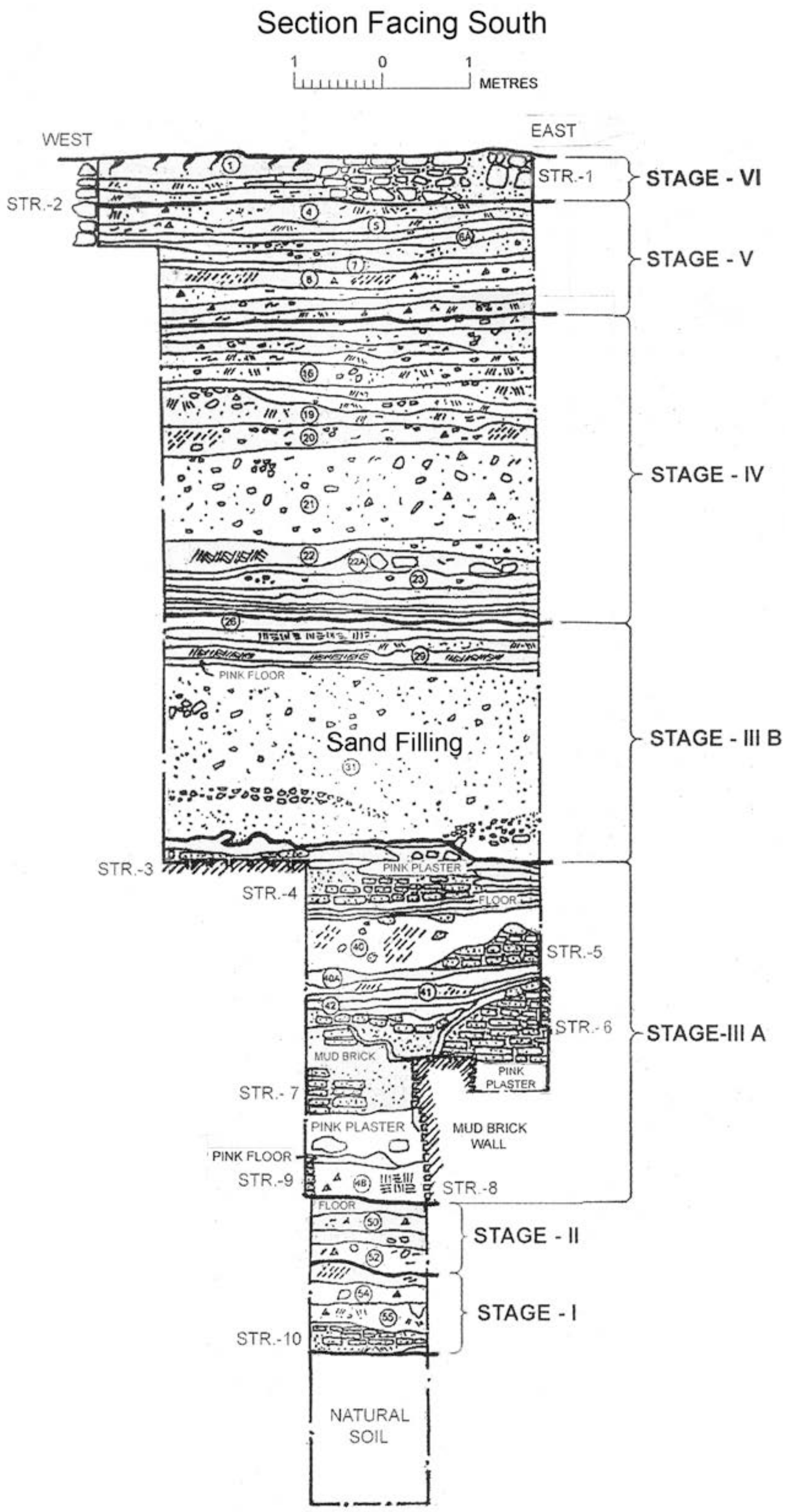


Fig. 5.3: Section facing south, Trench 55X5X2, Castle, Dholavira

Otherwise, the pottery forms found in Stage I continued in terms of fabric and typology. The pottery types of Stages I and II can be comparable with those found from the site of Amri in Sindh area of Pakistan. The pottery can be comparable with Period IIB of Amri and thus could be datable to the early part of third millennium BCE.

5.3 Stage III

Stage III, sub-divided into two phases, i.e. IIIA and IIIB, was most creative and important period in many respects: the southern arm of the antecedent fort-wall was further widened from the inner side with an additional brick-masonry of about 4.5 m and the pre-existing walled settlement was made into a castle while another walled subdivision, arbitrarily called as bailey, was added to it from the west; in the north, the extended residential area of Stage II was cleared of structures for carving out the aforesaid multipurpose ground; further north, the extensive walled town (which would become middle town subsequently) was founded; reservoirs were created on the south, west and north of the built-up divisions on an ostentatious scale and design; and, finally, an outer fortification was raised to surround all the above components.

For the first time, a seal of steatite, square in shapes, smaller and lighter but without inscriptions, appeared in addition to a potsherd bearing Indus signs and a solitary cubical weight. Besides, a good number of classical Harappan pottery forms with painted motifs made their debut. When the town of Stage III had lived two-thirds of its life, it was immensely damaged by a catastrophe. Its tell-tale marks are vividly present in the defensive wall and in a salient of the castle. Repairs were undertaken, the lower town was added and the city-walls were extended further eastwards in order to enclose the new additions. As a result, the erstwhile town attained full cityscape that dominated the cultural scenario for centuries through Stages IV and V.

Significantly, during the first three stages, i.e. I, II and III, the inhabitants exhibited an abiding preference for colourful clays, e.g., white and pink for plastering nearly all the structures whether defensive walls, roads, streets,

ceremonial ground, or the walls and floors of private houses. Not unlikely, even rooftops of the houses might have been treated similarly but, this tradition came to an abrupt end with the end of Stage IIIB and beginning of Stage IV, as if under a royal decree or by a resolute public consensus. At Stage IIIB, the cityscape had thus attained its fullest growth.

5.4 Stage IV

Stage IV belonged to that classical Harappan culture which has been so widely familiar to the people at large as it has been exhumed and published from a large number of excavated sites like Mohenjo-daro, Harappa, Lothal, Kalibangan etc. and known as 'mature' Harappan. Almost all the salient features of the city planning were scrupulously maintained at Dholavira along with the monumental structures such as gateways, fortifications, drainage system. The famous ten-signed inscription of unusually large size was surely in use during this stage. All the classical Harappan elements such as pottery, seals, weights, beads, items of gold, silver, copper, ivory, shell, faience, steatite, clay and stones are found in abundance.

However, local elements particularly in pottery are rather more dominant the classical Harappan types. There is a great variety of fabrics, forms and painted motifs. Besides the fabric, forms and painting traditions of Stage III also persists alongside. The use of coloured clays, white, off-white, pink, deep pink, plastering of structures and flooring of houses, was almost like signature phenomenon, but, as soon as Harappans arrived, the use of these coloured clays was totally done away with. This phenomenon leads to believe as if there was a change in power structure, i.e. political authority with a different ideological orientation.

5.5 Stage V

Stage V is characterized by the general decline particularly in the maintenance of the city. It is more vividly reflected in the citadel. As it has been observed by scholars, there could have been a laxity in the municipal administration of the overall city.



Fig. 5.4: View of a trench in Castle showing structural levels



Fig. 5.5: View of a trench in Castle showing stratigraphy

The other items such as pottery, seals, weights, etc., of the previous stage continued in use, however albeit with some changes in ceramics. The local ceramic wares show pyrotechnological deficiency, that is why those particular wares show tendency of becoming brittle, and flaking of in layers. Architecturally, they did not contribute anything, wherever there is a necessity of repairs, it was done in poor workmanship, however, it was not of a long duration at the site as it is reflected only in one structural phase. This phase too, also ended with the devastation of an earthquake, however, even sometime in the middle of this stage, the financial weakness if glaringly manifested in the evidence that the floods which devastated the water structures could never been made functional obviously due to increasing poverty, i.e. lack of resources. This stage was followed by a temporary desertion of the site, perhaps not lasting more than a few decades before the Stage VI ushered in.

5.6 Stage VI

Stage VI presents a state of cultural transformation. New ceramic traditions coming from the sides of Sind, Rajasthan, Gujarat and far-off regions in the north made their appearance. The one-time city shrank into a smaller town, confined to the citadel and the southern margin of the middle town only although some of the existing fortification walls were kept in use; a new wall of different construction was raised on the north for delimiting the settlement. The classical planning was largely given a go-by. Domestic buildings were laid out in a different planning. Bricks were no longer in use. While many of the pottery forms and decorative motifs of the mature period were still in vogue, new ceramic wares in the form of white painted black-and-red and black painted grey wares along with a coarse ware bearing incised or appliqué or both kinds of designs and also some Bara related pottery made their appearance. Many other traditional items continued in use though the seals underwent a drastic change. Rather being square in form, those were long rectangular with a flat or triangular or wagon vault back with a hole for passing a string. The seals still bore nicely cut inscriptions but, no one with any motifs. Beside the cubical weights of chert, etc. being still in use, some cut out of potsherds were also introduced. Overall picture that is projected is that impoverishment and rapidly crumbling urbanism. Having

lived there for about a century or more the late Harappans of Stage VI abandoned the settlement.

5.7 Stage VII

The above-mentioned desertion was certainly of a longer duration. How long? It is not certain at present. The new comers of Stage VII had forgotten all the classical Harappan fabrics, shapes and designs. Strangely enough, the newcomers built their houses in an entirely new form that was circular, so called known as *bunga* or *kud* and can still be seen in a greater part of rural India. No planning as such is discernible. All the urban attributes became conspicuous by their absence. Thus the urbanization that made its humble beginnings in Stage I and went on progressing through Stages II, III and IV, started decaying in Stage V and underwent a transformation in Stage VI with a feeble revival only to become totally deurbanized in Stage VII. The site was never occupied thereafter. Lying between the monsoon channels and being undulating sloping towards the south, the site was ideally suited for a settlement having artificial dams and reservoirs.

Chronology

Keeping in view of stratigraphical sequence, position and basic cultural forms chronology for various cultural divisions have been finalised for several Harappan sites, which were later dated using radiometric dating techniques. In addition to what dates have been obtained for Dholavira, a chronological sequence developed for Dholavira is tabulated below:

	Chronology	**Dating**	**Cultural Affinity**
Stage VII	c. 1500 – 1450 BCE		Later Harappan Culture
Stage VI	c. 1950 – 1800 BCE		Late Harappan Culture
Stage V	c. 2100 – 2000 BCE		Harappan Culture
Stage IV	c. 2500 – 2100 BCE		
Stage III	c. 2800 – 2500 BCE	DHR 93/TL/4 2809±461 BCE	Dholavira Culture
Stage II	c. 2900 – 2800 BCE	DHR 93/TL/8 2302±480 BCE	

Stage I	c. 3000 – 2900 BCE		

The TL dating for four samples are available from the Physical Research Laboratory, out of which two are erratic and not consistent with the habitation remains. Considering the difficulties in dating using TL technique, the dating results are not surprising. Two of the dates as indicated above are reliable, even though one date for Stage II is not consistent with the chronology developed based on stratigraphical and typological considerations. As it can be observed in the above table, one date for Stage III from PRL falls consistently and a date of 2809±BCE is obtained. However, the date for Stage II by using this technique does not fall within the consistent levels and hence reliability of this date can be questioned.

Chapter 6

6.1 Excavated Remains

6.1.1 Planning

Right from the early years of excavation at Harappa and Mohenjo-daro in early twenties of the 20^{th} century it had become obvious that the civilization that was being brought to light slowly and steadily by the archaeologists was a highly urbanized and sophisticated civilization which, among all other things, had standardized planning as well as architecture, both public and private. The planners and architects had taken utmost care for streets, lanes and by lanes which defined the residential sectors and blocks and provided easy access to them. As a rule, those were laid out straight and cutting each other usually at right angles. The streets running along the longer axis of a settlement ran straight and uninterrupted and served as major thoroughfares, while those crossing them were generally made staggered, not crooked however, and it was these which were meant for approach between as well as within sectors and blocks. It had also become obvious that sanitary drainage to carry away sullage from bathrooms, kitchens and well areas, and possibly a slightly different system for sewage (heavy matter and body waste). The great bath at Mohenjo-daro was rated high for its architectural fineness, and the same may be said of the cascading series of tanks dug out all around within the city walls at Dholavira. Banawali has added a new feature in having a broad and deep moat surrounding the town walls.

As more and more settlements well excavated the Harappans' skill in planning and architecture became obvious. To cite a few are: Chanhu-daro, Lothal, Kalibangan and Dholavira, all of which are examples of regimented planning. Of course, the two eastern divisions of the city at Harappa and the entire town of Banawali are exceptions in having curvilinear outline, instead of being parallelogram, as others are, by and large. In such situation too, street-system played a significant role. Outline in all cases is determined by fortification which appears to be an essential feature of all Harappan settlements, large or small, or even divisions and sub-divisions within. Another significant feature for

any Harappan settlement, whether a city, a town, a fortress, or a village, a set of principles mensuration with definitive ratios and proportions within and overall seem to have been rigorously followed. The best example of it the city of Dholavira necessarily owing to its being excavated under a strategy and rigour.

6.1.2 Settlement in General

The city of Dholavira in its fullest form was a precisely proportionate whole and proportionality resolved configuration following a resolute set of principles of planning and architecture with mathematical precision and perhaps with astronomically established orientation. Of the city, at present, three corners with partially eroded towers but fully intact inner corners are fairly traceable and thus confirmed by excavation. Those are lying in the north-east, the north-west and the southwest. They together have provided the northern and the western anus of the outer for fortification. When measured on the ground from the inner corners to the corresponding inner corners, the E-W length along the northern defensive wall and N.S. one along the western one worked out to 771.10 m and 616.87 m, respectively – thus giving the precise ratio of 5:4. Similarly, the other divisions of the city also revealed amazing ratios and proportions which rather provided in all other major and minor entities of planning and architecture. However, in the following table only some principle features are taken into account:

Sl. No.	Division	Width	Length	Ratio
1	City, internal	616.87	711.10	4 : 5
2	Castle, internal at available top	92	114	4 : 5
3	Castle, external (as per present exposure)	118	151	4 : 5
4	Citadel (castle + bailey), external approximately (including bastions)	140	280	1 : 2
5	Bailey, internal	120	120	1 : 1
6	Middle Town + Stadium, internal	290.45	340.5	6 : 7
7	Middle Town, excluding Stadium, internal	242	340.5	5 : 7
8	Stadium, internal	47.5	283	1 : 6
9	Lower Town, built-up area	300	300	1 : 1

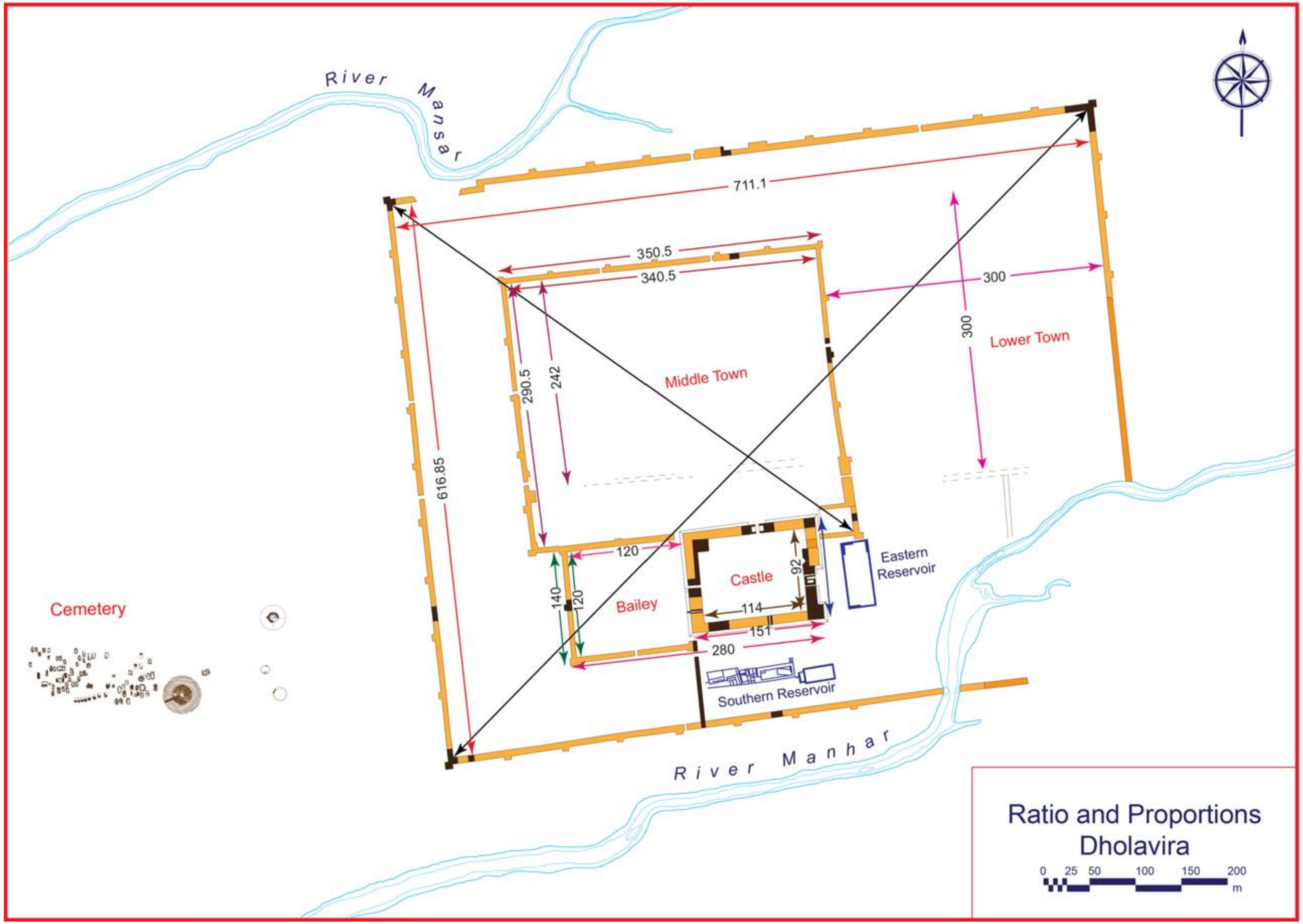


Fig. 6.1: Plan of Dholavira showing the ratios and proportions

We have seen the precisely proportional relationship between the castle and the city. It should be worthwhile to find out whether there existed a similar inter-relationship in terms of locational disposition as well. It did indeed. The diagonal drawn between the two opposite angles made by the north-eastern and the south-western corners of the city touched the north-western corner of the castle. Of the remaining two, the south-eastern corner is still missing, or not found out. Therefore, a line bisecting the angle of the remaining city corner in the north-west into two equal halves was extended towards the south-east. Surprisingly, this line not only bisected the angle of the corresponding north-western corner of the middle town and further on cut across a crossing of major streets in the same division but also struck the north-eastern corner of the castle. This could have been achieved by mathematical calculations and drawings. In the whole scheme, the enwalled area of the castle became 49th (7 x 7) part of that city and total built-up area of the former 25th (5 x 5) part.



Fig. 6.2: View of Castle showing the processional pathway

The two third of the middle town was laid out with three bold projections and two recesses provided on either side of the arterial street running from east to west. It can be Better visualized if one recalls the indented ground plan of a developed Indian temple having projections and recesses on all four sides. In the middle town, there are seen two full and one half such units of which the slightly

smaller one is in the western part, larger one in the middle and the half on the east where the last-mentioned one is bounded by the inner peripheral street that runs along the eastern defensive wall of the town. Another significant feature is the arterial street that run across axially from west to east dividing all the above mentioned units and sub-unit into two equal halves, and a north-south street, perhaps somewhat staggered, further subdivided each unit: Thus, rendering each unit having four built-up areas subdivided by streets. This kind of layout of the town helped carve out six open spaces in between the surrounding fortification walls and the built-up areas.

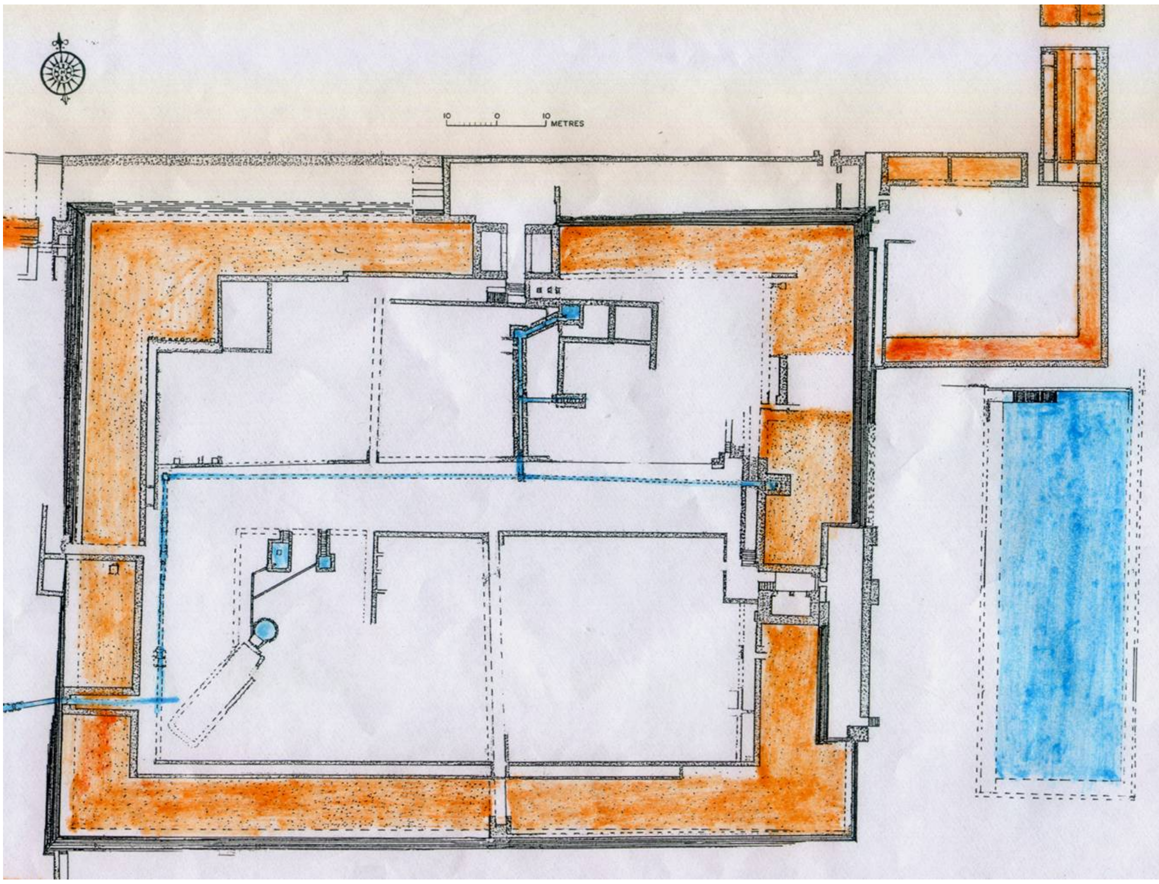


Fig. 6.3: Plan of the Castle, Dholavira

However, on the southern margin of the town the resolution seems to have been entirely different in that there was a straight, continuous and rectangular built-up area running from one end to the other between the bounding fortifications walls running along on the eastern and the western sides. This built-up area was also subdivided by a street into two equal halves along the east-west axis. These observations are based on the meagre excavation in proportion

to the wide expanse of the middle town. Indications are also available to state that each bold projection of a unit might be having likewise a series of minor projections and recesses in each case.

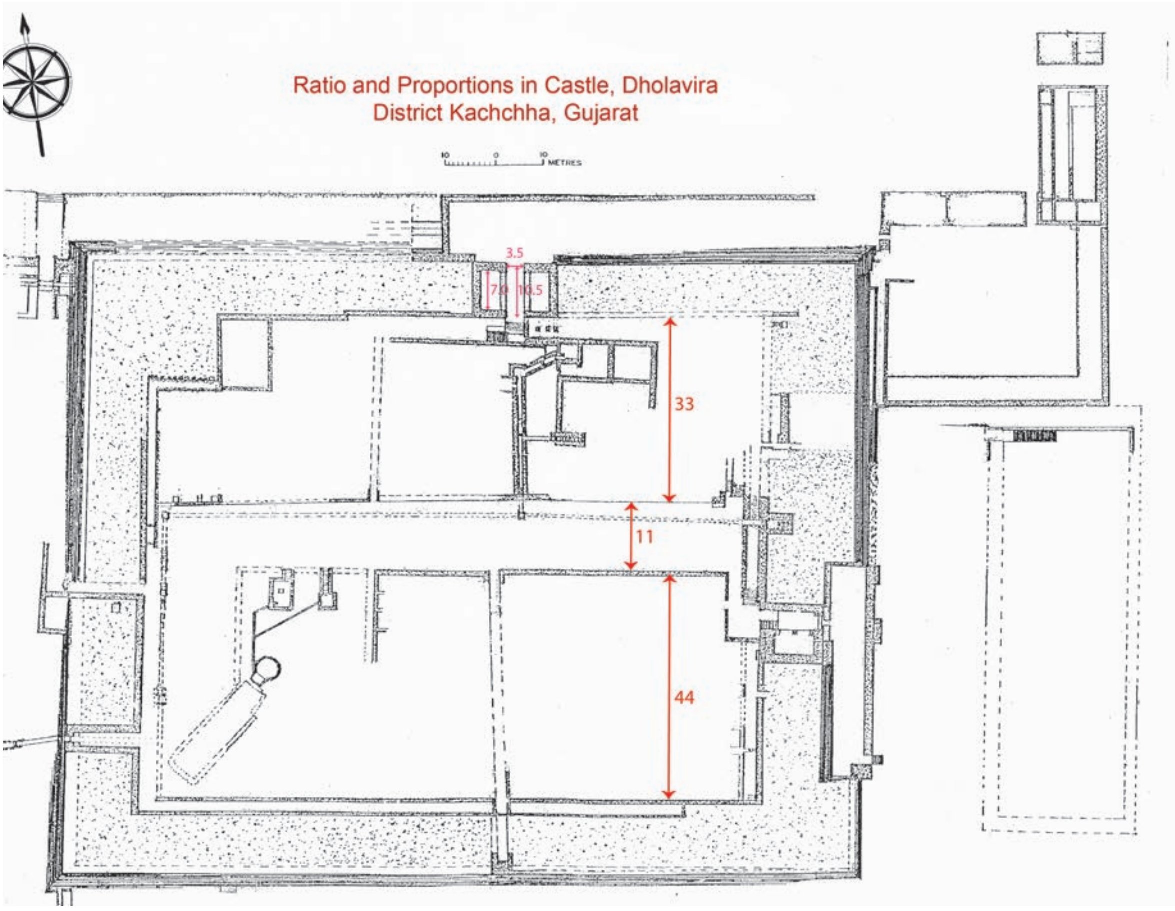


Fig. 6.4: Plan of Castle showing ratio and proportions

More or less in a similar way, rather in a little more complicated fashion, the lower town too was resolved into several units. That network of units still remains to be studied. Each unit seems to be having likewise projections and recesses and in turn demarcating an open space, of course. The arterial street of the middle town passed through a gate in eastern fortification wall and then went on running across the lower town albeit with a few turns, each at the end of a residential sector. The street however remained uninterrupted. Other major and minor streets and a lane shot off from the axial street for making a defined network of housing sectors.

6.2 Architecture

6.2.1 Fortification

Ideally suited for a settlement, well provided with fortifications, built-up areas and artificial reservoirs, the site lies between the storm-channels and halfway down between the hills and the Rann. The site has a few rocky protuberances and ridges, surrounded by a thick pile of naturally deposited sediments. The fortification walls, both inner and outer, were structures of proportionately moulded mud-bricks, successive courses being laid in a recessed manner. As a result, both faces showed a marked taper with receding steps. While the outer faces were normally veneered with rubble and hammer-dressed stones, the inner ones were periodically plastered over with fine clays. At vulnerable places or near the gates, the inner face too was provided with stone-facing.



Fig. 6.5: Northeastern bastion of outer fortification, Dholavira

The outer wall which was constructed in Stage III and remained in use throughout Stage IV and V and partly during Stage VI runs for a length of 781 m

along the east-west axis on the north and 630.50 m along the north south on the west. The southern arm is traceable for a distance of about 600 m and the eastern one for 210 m with a vague indication for another 100 m. in the east, the ground being higher and more vulnerable to surface water and wind action, the eastern wall and half the northern wall had suffered considerably to the extent of being obliterated for stretches. In the south-eastern quarter, particularly across the Manhar nallah, the wall, if existed at all, is not traceable now. Another, interesting feature is the provision of projection salient almost at regular intervals. Depending on the presence of vaguely to fairly observable remains there were provided, excluding the corner towers, 11 salient along the northern and 9 ones along the western arm of the city-wall, roughly at a distance of 50 to 52 m. Similarly, salient can be seen along the extant segments of the other arms too.



Fig. 6.6: Northwestern bastion of outer fortification, Dholavira

Likewise, there were 5 salient along the northern and 4 along the western arms of the middle town. Barring a smaller one in the south, no other gateways piercing through the outer walls has so far been exposed although there are certain prospective points. Of course, one gate provided in the east end of the middle town is laid bare while a few others are suspected in the other arms as well. In the castle, there was provided an impressive gate somewhere in the middle of each arm, although in the eastern wall a wide opening furnished with a

flight of broad steps going down thickness of the defensive wall in addition to a regular gate. But, surprisingly, the steps in this gate under reference stopped on the outer edge of the wall and never descended onto the lower ground level on the east-thus rendering its function indeterminate.



Fig. 6.7: Southwestern bastion of outer fortification, Dholavira

6.2.2 Gates

The Castle was found provided with five gates pierced through the fortification. Each one has revealed a distinct design. While the eastern arm has yielded two gates, there was one in each of the remaining three walls. The south gate has a concealed passageway with an ordinary doorway at its southern end where it was connected to a flight of wide steps descending to the northern embankment of the rock-cut reservoir. As already stated, it was in use during Stage III but was sealed off something in the following stage of Stage V. The West gate which afforded intercommunication with the bailey was in the form of a 9 m long and 2.2. m wide passage way with a small guard room carved in the southern wall while the northern side was found washed away completely to the floor level of the passage. The sloping passage way has a few steps at the outer end which was provided with the steps made of large limestone slabs one of

which may be seen as a plano-convex with rounded sides placed as the lowermost steps as of now.

6.2.3 East Gate

The East Gate one of the two principal ones had a large chamber consisting of an elevated side-chamber on the south and a collateral sunken passageway on the North (fig.2). The passageway was connected to a flight of 14 steps at the inner end while it was fitted with a doorsill made of large lime stones slabs at the outer one. At both the ends, it must be having huge doors. At either end on top of the side wall of the elevated side chambers, there was found a set of nicely cut and smoothened limestone block of rectangular shape. The topmost block bore two long sockets one each on two sides and parallel to each other. As evidence had it, each set of the blocks was the base for a pilaster, made of mud concrete bricks, and built to the ceiling of the gate chamber (fig. 3). Each pilaster was probably veneered with a wooden casting which was closed fit by a grooved and longed joint into the couple of sockets.



Fig. 6.8: East Gate of Castle, Dholavira

In the centre of the side wall was found another limestone block supporting a beautifully carved and polished pillar base having a pronounced concave profile

and straight sided bottom and top surfaces were flat. The top surface bore in the centre a 5 mm circular hole. By the side of it, two large-sized pillar members with rounded sides and flattened top and bottom were found lying dislodged. Each flat surface of both the members also showed a similar hole for receiving a dowel. In front of the gate, there was exposed a high terrace raised between two massive flanking bastions. The provision for access made in the form of jerry-built set of steps at the southern side of terrace was a creation of Stage VI while the original approach seems to be lying still concealed under the late Harappan structures. It must be added that, during Stage V, a number of domestic/industrial buildings were raised on the terrace of the gate.

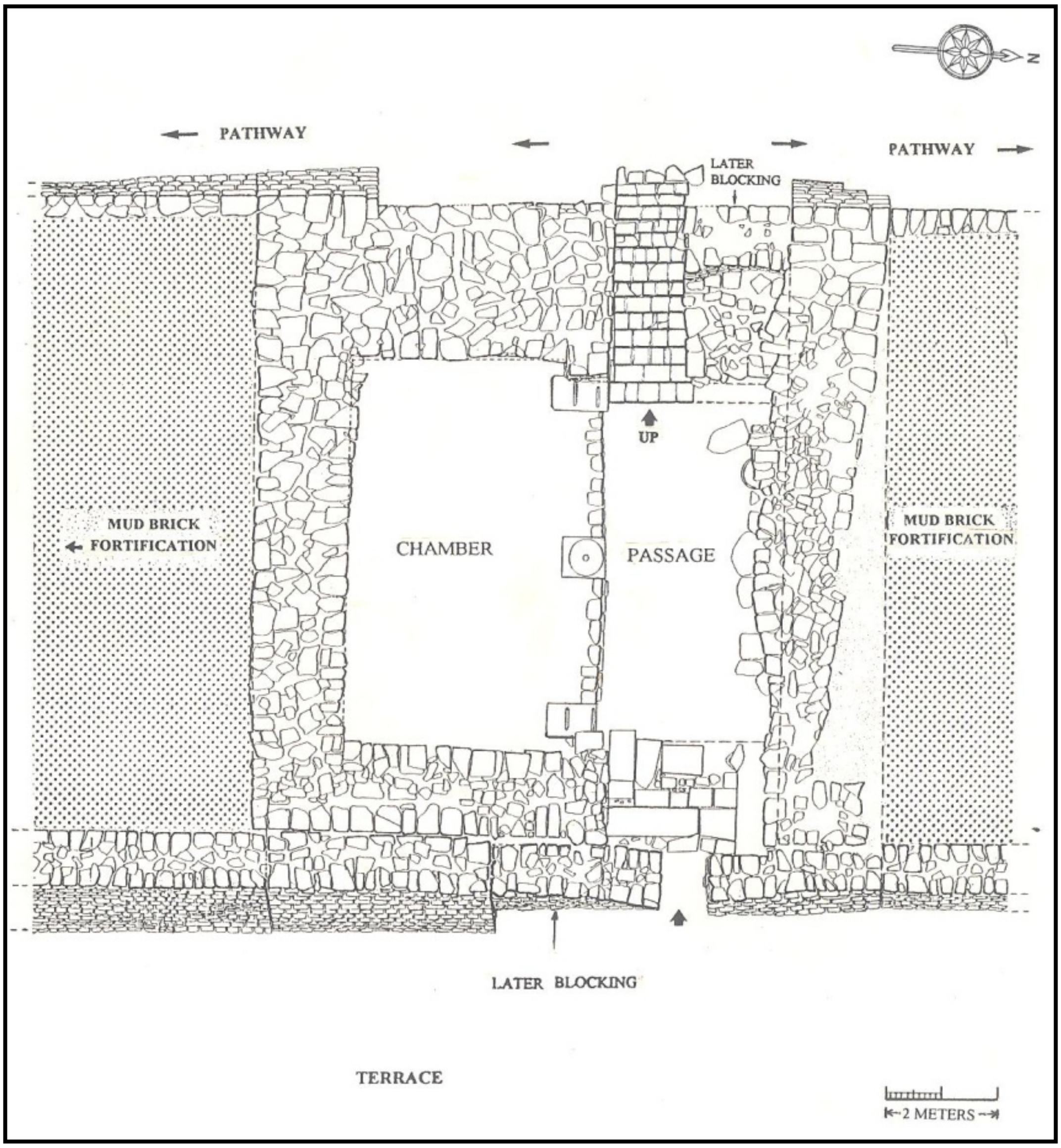


Fig. 6.9: Plan of East Gate of Castle, Dholavira



Fig. 6.10: Eastern arm of fortification of Castle, Dholavira



Fig. 6.11: General view of East Gate of Castle, Dholavira

The East Gate 2 is provided with a series of broad steps going down from the top but terminating higher up on the outer edge of the defensive wall without yielding any evidence of descending to the ground level on the east.



Fig. 6.12: Southern chamber of East Gate, Castle, Dholavira



Fig. 6.13: Passageway of East Gate of Castle, Dholavira

6.2.4 North Gate

The North Gate was found to be the most majestic, most elaborately designed architectural construction which commanded over the stadium, the middle town, the lower town and further beyond the picturesque landscape. In

the thickness of the wall, it consisted of two elevated chambers flanking a sunken passageway which, in turn, was furnished at the inner end with a limestone doorsill flanked by a set of limestone blocks each bearing pilasters sockets on two sides – thereby suggesting the existence of two enormous columns (made of stone masonry) encased by wooden panels.

Those columns may have supported the heavy door frame fitted with two door leaves. A similar provision seems to have been made as well as the outer end of the passage ways evidenced by the door sill with a limestone block bearing sockets at one end, while the other one was replaced with ordinary blocks at a later time. As the east gate had marvellous bases of a central pillar and two pilasters on the elevated chambers of the north gate as well, although not found intact due to the vandalism wrought by the late Harappans of Stage VI. Similarly there was a 12 m wide and perhaps 33 m broad and 5.6 m high front terrace majestically overlooking the stadium.



Fig. 6.14: General view of North Gate of Castle, Dholavira



Fig. 6.15: North Gate of Castle, Dholavira



Fig. 6.16: Processional path of North Gate of Castle, Dholavira



Fig. 6.17: Internal arrangement of North Gate of Castle, Dholavira

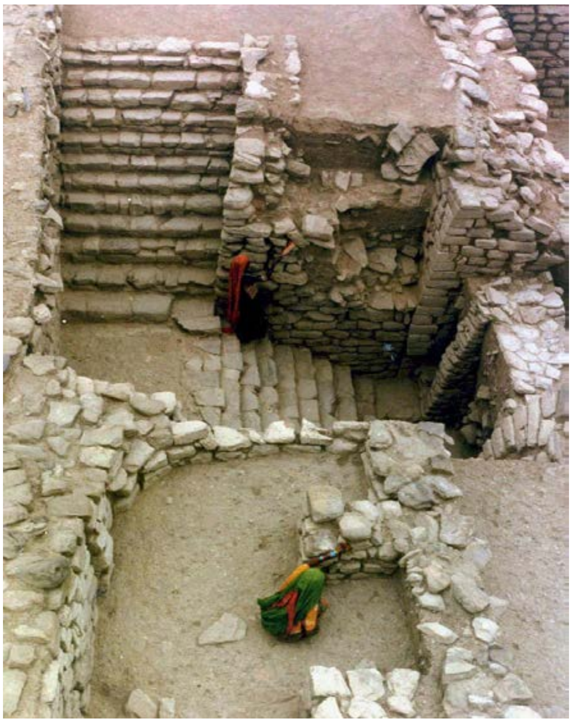


Fig. 6.18: Details of stairway leading to the interior of Castle, North Gate, Dholavira

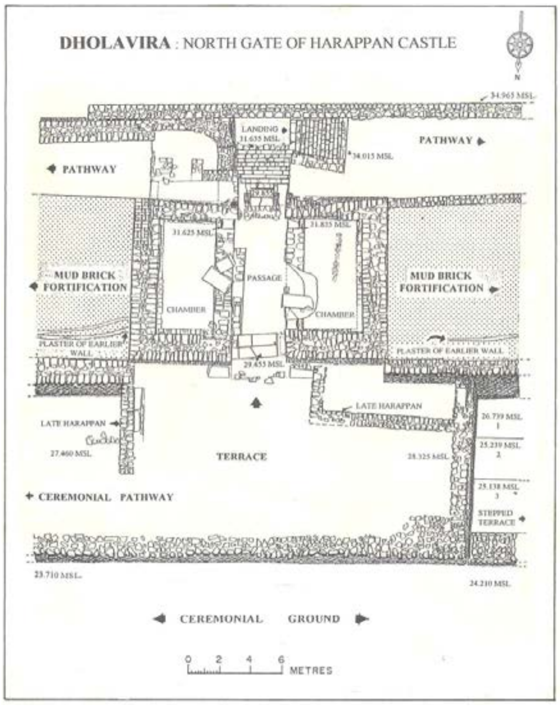


Fig. 6.19: Plan of North Gate of Castle, Dholavira



Fig. 6.20: East Gate of Ceremonial Ground, Dholavira

On the east and along the high fortification wall, the terrace was connected with a 9 m wide 'ceremonial' pathway descending onto the stadium or 'ceremonial ground' through a gate wide as much. It was, however, reduced in width in Stage V or VI. AT the inner end of the passage way of the north gate there was an L shaped staircase having 10 steps, a landing and then another flight of 13 steps turning at a right angle towards the west. Barring the southern one, the other three gates remained in use from Stage III to Stage VI although the last occupants neither maintained them well nor spared them from misuse. The north bailey gate was constructed under the shadow of the towering north-western corner of the castle. A flight of steps gave access to 7.30 m long and 2.30 m to 2.55 m wide passage way which too was flanked by chambers. It facilitated intercommunication between the bailey and the stadium.

The south bailey gate was likewise built under the shadow of the south western corner of the castle. Further details of the gate are yet to be collected by further excavation. The east gate of the stadium was also an impressive construction with a guard room on the southern side and a sentry post set in the northern wall. The passageway measured 12.20 m long and 3.80 m broad. The

west gate as a simple opening was to provide movement between the two stadia. The east gate of the middle town was flanked by two bastions. Originally, it comprised two flanking chambers which were got filled up with stones subsequently. At its outer end, there were fitted stone slabs across the width. Those slabs bore two set of grooves perhaps for receiving tongs of some sorts of wooden planks for closing the gate.

The south gate through the city wall provided access to annexe and the rock cut reservoir towards the outside it, however, opened on to a large enwalled area attached to the city wall from the southern side. The subjoined area perhaps housed the state animal farm. Another gate in the annexe area was laid bare in the western bounding wall which lies N – S, joining the city wall with the citadel wall. Another gate not yet fully exposed stood to provide movement between the smaller stadium and the reservoir area lying to the east of the castle. Yet another gate uncovered this year offered approach to the stadium as well as to the settlement of Stage VI.

6.2.5 Multi-purpose Grounds

Identification of two multi-purpose grounds as integral elements of urban planning at Dholavira is yet another contribution of immense significance. These grounds strongly appear to have been used as stadiums as well as seasonal trading areas in addition to miscellaneous social and other activities as observations made during excavations may throw light on. If that be so, these should be the earliest and impressive features of the urban planning of the Harappans and will go a long way in interpreting anew the almost such open spaces found at other sites as well. It may be recalled that there exists an open space at Mohenjo-daro, at least as long as 400 m or even more, between the mounded areas of the citadel and the lower town. Almost the same feature occurs at Kalibangan. At Harappa, there is a sprawling area to the east of citadel which incidentally falls to the north of mounds E and ET and, perhaps, bounded by another urban division on the north where the present village of the same name is perched on it. If properly investigated, it is presumed that all such open areas may reveal what Dholavira has represented as multi-purpose grounds

which have been arbitrarily designated as great ground (GG) and little ground (LG).

The location of the GG between the citadel and the middle town, as already defined before is important. Equally important is the fact that it was strongly fortified and well provided with gates for providing access in to it from outside and also such gates which provide due inter-communication with each of the sub-division of the citadel on the one hand and middle town, lower town and little ground on the other. The very location as well as its being well defended and well-furnished demonstrates the importance of both the grounds.

The earliest and the largest stadium found so far in antiquity may be accredited to the Harappans. The great ground, measuring 283 to 285 m E-W and 45 m to 47.50 m N-W, lies between the citadel and the middle town and is circumscribed by well-defined architecture. Along the south, there are three distinct segments: the first stretch in the east is the wall-cum-sitting terrace which separates it from the little ground; the second is the 80 m long ceremonial pathway ending on to the platform of the north gate; and the third one, supporting four or five stepped terraces runs partly along the citadel and the bailey. The entire length is punctuated by entry gates or openings giving access to the little ground, processional pathway and the bailey. On the west there is a broad and long passageway running along the fortification wall of the bailey. To the north of it a small scale excavation revealed the presence of stands. The second and the third parts abut on to the northern fortification wall of the citadel inclusive of castle and the bailey.

Almost on all sides, excepting the stretch of an 80 m appropriated by the north gate and the appurtenant ceremonial pathway, it was provided with stands for seating of spectators. The broadest one, 12 m wide, having three or rather four continuously running tiers or terraces, in ascending order, was made abutting the defensive walls of the castle and the bailey. Steps for seating have been seen also atop the enormous defensive wall that stood to the east of the stadium. A similar arrangement of steps is emerging at the west end too. The

stand that lay along the middle town or on side of smaller stadium did not show the stepped construction due to perhaps the erosion of the centuries.

The smaller stadium lay under the shadow of the preeminent castle. It was created in the area that was extending from the north-western corner and the east gate 2 of the castle. It was provided with two gates: one for inner communicating with the larger stadium and the other with the eastern outfield and the reservoir area lying extending to the east of the castle. As held before, those stadia which were multi-purpose grounds perhaps are altogether new features of the Harappan planning as well as architecture.

6.3 Streets and houses

6.4 Middle Town

The ruins of the middle town situated north of citadel and west of sprawling lower town are scattered over an area roughly measuring 340 m EW and 242 m NS (excluding Stadium internal) with a maximum rise of 8.5 m. So far if we look into the ratio proportion of the measurement of said part of the city it stand 5:7. Like the citadel, it too, is found well-fortified and at the same time separated from the outer wall by wide vacant areas on north and west and from the citadel by another space. This division runs parallel to the Citadel and rather slightly out measures it in length both east and west. Within its walled area too, there are vacant spaces; a wide open area in west. In addition to two open quadrangles each on north and south. From three sides, these quadrangular areas are closed in by built-up houses. The defenses are found duly provided with bastions and gates at frequent intervals.

The two third of the middle town was laid out with three bold projections and two recesses like the developed Indian temple ground plan having projection and recession on all four sides provided on either side of the arterial street running from east to west. Apart from this each bold projection units were having minor projection and recess. In the middle town, there are seen two full and one half such units of which the slightly smaller one is in the western part, larger one in the middle and the half on the east where the last-mentioned one is bounded by the inner peripheral street that runs along the eastern defensive wall of the

town. The width of the outer peripheral street is approx. 4.7 m. Narrow gaps and passages gave evidence for sub streets and lane which quite possibly ranges from 2.5 m to 0.75 m.



Fig. 6.21: East Gate of Middle Town and view of excavated trenches



Fig. 6.22: View of a crossroad, Middle Town, Dholavira


Fig. 6.23: View of excavated trenches with Castle in background, Middle Town


Fig. 6.24: A house complex in Middle Town, Dholavira



Fig. 6.25: A house complex in Middle Town, Dholavira

Another significant feature is the arterial street that run across axially from west to east dividing all the above-mentioned units and sub-unit into two equal halves, and a north-south street, perhaps somewhat staggered, further subdivided each unit: Thus, rendering each unit having four built-up areas subdivided by streets. This kind of layout of the town helped carve out six open spaces in between the surrounding fortification walls and the built-up areas. The purpose of these open spaces are yet to be determine but it is likely that some part of these open spaces might be used as dumping ground or may be as children's playground.

The southern margin of the town the resolution seems to have been entirely different in that there was a straight, continuous and rectangular built-up area running from one end to the other between the bounding fortification walls running along on the eastern and the western sides. This built-up area was also subdivided by a street into two equal halves along the east-west axis. The street pattern of the Middle town is somewhat more particular than the Lower Town.

The width range of the E-W arterial street is from 4.35 to 5.30 m. on the other hand the N-S oriented street is somewhat staggered and their width ranges from 1.65 m to 2.55 m.

In the area of Middle town almost three trenches goes up to the natural soil at a depth of 8.55 m, these are 35 x 83, 45 x 63 + 73, and 45 x 43.

Trench 45 x 43 was dug up to the natural soil at 8.55 m. it is observed that the habitation started here in early stage of stage III. This trench is nearly on the E-W oriented street and also gives accesses to N-S oriented lane. Total 51 layers are detected which can be seen:

From layer 1 to 6 is brownish grey in colour represent stage V.

From layer 7 to 25 is generally represents stage IV brownish in appearance intermingled with light green colour which shows that it is a street deposit.

From layer 26 to natural soil refer to stage III is dark brownish ochre coloured with presence of some charcoal.

The prominent finds from this trench indicate that shell bangles outnumbered the terracotta bangles in stage V and there is an enormous use of consumer goods of diverse materials especially abundance of copper in this stage. The number of bones exceeded those of potsherds and chert blades were also found in large numbers in stages IV and V. Another interesting feature is the presence of white coloured plaster in layers 25 and 26 and in layer 27 a red paving was also noticed.

The trench 35 x 73 whose southern half is of having street deposit contain pits must have been made in order to even out the street level and of two kinds as observed by trench supervisor, who define its nature according to material finds from these pits. Among them first category of pits are having industrial

debris while the another one is said to be or proposed to be burial pits (whether because of its orientation as E-W or due to its oval shape).

6.5 Lower Town

6.5.1 Location and Boundaries

The lower town or in Rig Vedic term 'avama' situated on north-eastern side of the city and to the east of middle town. This part of city together with middle town and citadel form an L-shaped design. The total area of lower town is 300 meters E-W and 330 meters N-S excluding the outer fortification wall, so that the total ratio will becomes 10:11. The total length of the wall is 781 m (E-W), while total width comprises 630.50 m (N-S). The outer wall constructed during the time of Stage III and continued to be used till Stage IV, V and VI.

Lower town doesn't have its own fortification rather it is well within the outer fortification wall, eastern and northern city wall, while on the western side of lower town a similar peripheral wall running along eastern arm of middle town shared by both the divisions. Although it may more pertain to the middle town, possibly administratively. However on southern side the outer fortification is faintly visible. The general landscape of the site suggests that the city contours are spread in fans out like fashion. So far the maximum height in said area concerned it is 7.5 m. The northern most limit of the lower town is exposed in grid 23 (23x8, 23x9, 23x10) where the limit and extent of N-S running street is also seen. It is here only were a skeleton in crouched position exposed from excavation (23x9). Falls fully into the eight grids, it occupies nearly 1/3 area of the eastern half of the fortified city, which comprises grids from 13 to 16, 23 to 26, and parts of 2 to 6. Although it doesn't have its own fortification wall, It covers an area of about 1250 squares inclusive of the fortification wall and partly of the outside peripheral wall of northern and eastern side. It was demonstrated that the lower town came into existence during stage IIIB and survived through stage V although some stray finds of stage VI were found on the surface or sub-surface level.

6.5.2 Excavation Strategy

As already explain in the chapter of excavation strategy only one row of squares running from east to west and rows from north to south were chosen for exposure obviously for understanding street system as well as extent of built up area, in respect to operation area. Diversion was made only at two places, 1) in the north-eastern corner of city wall and (2) in the 5 squares….. lie in the arterial street which emanates from the east gate of middle town.

In case of the former the objective was obviously was to confirm the presence of the northeastern corner tower, of the city wall, understand its makeup and state of preservation and some possible features of planning and architecture related to that construction/structure. The margin of error is 0.5% so far its measurements are concerned. The excavation in this area lasted to thirteen field seasons.

6.5.3 General Strategy for Exposure

As per strategy most of the squares were excavated to a depth of 1. 50 m in general exposing only one or two structural phases but a few of them sunk to the natural soil (namely square 15 x 24, 35 x 24 and 25 x 83) which help in reconstruction of history of this part of lower town. Mostly structures belonging to stage IV and V were exhumed. Only three trenches were dig up to natural soil as already mention is 15 x 24, 35 x 24, and 25 x 83. The colour of natural soil is found to be slightly yellowish in appearance mixed with kankar. These trenches exposed 42 layers which again divided into 8 structural phases. The maximum depth recorded from these trenches is 6.55 m; however the total material deposit seems to be more or less 6.30 m.

From layer 1 to 4 falls under 1st structural phase belongs to mature Harappan phase (90 to 92 cm)

From layer 5 to 10 falls under 2nd structural phase (127 cm)

From layer 11 to 18 falls under 3rd structural phase (38 cm)

From layer 19 to 26 falls under 4th structural phase (156 cm)

From layer 27 to 33 falls under 5th structural phase (99 cm)

From layer 34 to 36 falls under 6th structural phase (78 cm)

From layer 37 to 40 falls under 7th or 7B structural phase (47 cm)

From layer 41 to 42 falls under 8th structural phase or 7th having a brick paved floor over which a pinkish colour plaster is applied. Below that natural yellowish colour natural soil found mixed with small pebbles.

6.5.4 Streets

6.5.4.1 Peripheral Streets

These are the streets which are found along the fortification wall of the said part of the city. On the western side along with the eastern fortification of middle town a wide street is running N-S, the width is of 8.3 m. Similarly on the eastern boundary of the lower town along with the outer city wall there is another street running N-S is seen having approx. width of 4.75 m.

P1: Running along the outside of city fortification

P2: Running along the inside of city fortification

P3: Running along the outside of the middle town fortification wall which also encloses citadel.

P4: Running along the inside of the middle town fortification wall that also encloses the citadel.

6.5.4.2 Arterial Streets

The total area of 298.75 meters from E-W and 186.60 meters from N-S is excavated basically to know the extension of lower town and more precisely the street patterns of said part of the city. As mentioned earlier that the arterial street coming from the middle town through its east gate, albeit runs in general oriented E-W runs not straight, rather tortuously, with a southward shift making an angle at four intervals and lastly joining to the N-S running arterial street (exposed in trench 25) again making an angle continued in the lower town falling in grid 35 and 25. The width of this street ranges from 4.2 to 4.5 m. Another arterial street running N-S were exposed in the grid 25 that runs fairly straight, and can be seen in grid 25, 24 and in trench 23x8,9,10 in further north of the city.



Fig. 6.26: View of an arterial street, Lower Town, Dholavira

The width of this street is ranges from 4.75 m to 5.05 m. apart from this there are some other streets that may fall into the category of Arterial Street because of its width ranges from 5.2 to 5.8 m. these streets are found cutting the N-S oriented Arterial Street roughly at both ends (25x6 and 24x6).

6.5.4.3 Sub Streets

These streets are generally less than 4 m in their width (approx. 3.15-3.50 m)

Five more sub streets running north south and cutting the former at angles were brought to light, of varied width. Another thing to be mentioning here that there is no gate found so far in the lower town area. So, far till now total 14 small streets were exposed of varied width, among them six streets were branched off from E-W Arterial Street and eight branches off from N-S running Arterial Street thus divided the whole area into various housing blocks.

6.5.4.4 Lanes

These are the streets which are generally seen between the various housing blocks and probably used as intra communication way between various housing blocks. The width ranges from 1.2 m to 1.7 m (1.2, 1.35, 1.65, 1.7 m).

6.5.4.5 By lanes

These streets are generally less than 1 m in their total width and often observed that might be used for the purpose of inter communication between housing blocks. Two such by lanes have been found at the northern half of N-S oriented arterial street running E-W having width of 0.90 m.

However encroachments is seen on many places at street, probably took place in the later phase of Stage V. Rammed earth is used for the purpose of making these streets. There is no evidence of rut marks on the main streets of Dholavira it seems that Harappans didn’t allow bullock cart or any kind of vehicular traffic inside the city (at least in Dholavira) as also observed by the excavator itself (R.S. Bisht). On several points it is also observed that street was at little slope, probably to give a way for any kind of stagnant water. Like MT, LT too has not shown any provision of storm-water drainage; the gradient of streets

runs sideways to let off the rain water much of which seems to have been designed to a fresh water pool, such one is in the south where it was near to EW embankment.

This area was however yielded a few graves or cenotaphs which for want of concrete evidence cannot be dated. In almost all cases the pit of funerary features are found to have been cut at surface and pile of stones to circular oval above the ground.

6.5.4.6 Housing Blocks

The streets were flanked on both sides with houses along with platforms. So far till now around seventeen small big housing blocks were identified.

Housing blocks differ in their sizes, the smallest housing block measures 8.10 meters, while the largest housing block is of 65.35 meters area.

Apart from street pattern, structures included rooms and platform area. Rooms were having large and broad walls with nice, regular and occasionally paved floors. Building materials included stone cut in typical Harappan brick ratio (1:2:4) along with mud mortar and sometimes mud bricks. Soakage jars was kept near to the houses found to be half buried in the soil. Unlike the citadel, but like the middle town, lower town area did not possess long drains rather here only small drains are present which ended to soakage jars situated on the sides of sub-streets. Other notable structures are platforms found just outside the houses encroached the street pattern of city, thus resulting decrease in the actual width of the street. There actual purpose is yet to confirm but most likely either used for sitting, entertainment or for selling goods (market).

So far building material is concerned mostly mud mortar along with stone masonry. Mostly rubble and ashlar masonry are used but sometimes mud bricks are also engaged. The size of bricks is 40:20:10 cm.

6.5.4.7 Important houses

So far the rooms are concerned here are the few examples:-

(1) This structure is found in trench no. 5x84 under quadrant no. 1 and 4, here two rooms are found belongs to two structural phase. One of a room which

measures 3.15x2.10 meters surrounded by four walls whose width varies from 65 to 85 cm having floor made up of paved stones, while the other room is situated to its west. It is a simple room having two ghost walls, in its eastern part a grinder is placed in situ. These structures were seems to be of single structural phase (probably early phase of stage V). Contemporary layers are humus and layer 1 yellowish grey in appearance which is compact contains sand, silt, clay and kankar. Very little amount of antiquities are found from this quadrant (small chisel, bone point etc.).

(2) The structures found in quadrant 15x4 were considered quite important as it possess gold bead and chert blades. The trench is having three structural phases covering two stages (stage V and IV) along with 10 layers. A platform is exposed which measures 1.47x1.41 meters might be previously part of any structure contain two layers of plaster. Two more rooms were unearth from quadrant no. 1 and 4 that measures 2.50 m N-S and 2.30 m E-W another room lies in quadrant no. 2 and 3 which measures 3.20 m E-W and 2.11 m N-S. There is a covered drain belongs to first structural phase of stage V situated between these two rooms started from quadrant 2 and ends in the north direction of quadrant 3. The width of this drain varies from 26 cm to 42 cm. Apart from these two rooms and drains there is a small platform situated between two walls measuring 1.82x1.45 meters is also found. This so called platform might be used for bathroom purpose as observed by the trench supervisor.

(3) The structure found in trench no. 25x2 under the quadrant 3 and 4 is situated near the N-S running streets which intersect the E-W running main Arterial Street at right angle. Here 6 layers are present up to 1.10 meter under which three types of structure is found. Length of the wall is 3.10 mt., height is 0.90 mt. having seven courses, and however width is not exposed. Apart from the room area there is a bathroom and kitchen area where there is earthen hearth in U shaped along with a number of pots, terracotta cakes and a big pot. There is also rectangular veranda

having two courses of stones. The house door opens towards the street side. Besides this there are some ash filled pits along with the street side which might be potter's kiln or metal smith's kiln which is proved by the street side dump and pits from where consider amount of copper rods and other materials along with sealing with Harappan characters is found.

(4) In trench no. 25x2x1+2 possess a structure which is adjacent to the street. The dimension of the structure length is 3.25 meter from north to south while width is 0.35 meter having two courses. Another ghost wall is been seen running west to east measures 1.40 meter length wise and width is 0.48 meter situated near to sub street.

(5) Trench no. 15x24 posse's structures situated near street runs N-S whose original width is 5.25 meters which was at later stage encroached by a wall of stage V, here natural excavation dug up to natural soil at the depth of 2.17 meters. There is an alignment of mud bricks on edge in quadrant four. It is observed that there is two structural phases in the structures of this trench. Apart from structures large numbers of antiquities (more than two hundred) were also reported from the trench.

The first structure that found is a wall coming from north and going to south in quadrant 1 than in quadrant 2 it turns towards west and again turns towards southward joining the another east west running wall. This wall is sealed by layer 3. In quadrant 1 another wall going east-west is spring out from north-south running wall and after some length turns towards northward, thus forming a somewhat square.

At the western half of the trench there is a presence of ghost wall running north-south. There is also existence of a white clay floor found at a depth of 1.26 meters at the northern section running in E-W and turns right in N-S and merges on to the plan. Sealed by layer 11 this floor is 4 cm thick having ash filled deposit at its base might be used for levelling purpose.

6.6 Water structures

The south-western corner of the castle seems to have been reserved for water structures such as a large well, two water tanks, drains and some associated architectural features. The well, perhaps the largest one found so far in the Harappan context, has its internal diameter of 4.25 m in the north-south direction and 4 m along the east-west. The distortion is due to the lateral thrust from the direction of the east and the west. The original diameter may have, therefore, been 4.125 m. On the south-western face of the well a high degree of skill is manifest whereas on the other sides the gushing surface run-off during the period of desertion has caused much damage the stonework of the shaft.

As a result, the stones of the face work particularly in the northern part have been rendered to be rounded off showing yawning gaps. The well has been evacuated to a depth of 13.60 m. For striking the water table another about ten meters of excavation may perhaps be necessary.

On the available evidence, it is almost certain that the well was certainly in existence during the Stage IV and had been used all through up to Stage VI. It is not unlikely that Stage VII people might have drawn water from it. Only full excavation can settle this issue as the stratigraphical context in the subsurface in the immediate vicinity have been found poorly preserved although, a little distance away, many a circular hut of the ultimate stage is duly present in well-preserved condition.

So far the first phase of construction of the well is concerned; it can be ascertained by only deep digging down the exterior of the well shaft. Significantly, the basal slab of the trough bore rope marks.

Besides, some slabs bearing deep rope marks due to their use for a longer period and thereby rendered unfit for further use have been found as discards in course of excavation. It is also interesting to record that there was found a pile of stones showing a fairly orderly collapse of a structure.



Fig. 6.27: Tanks 1 and 2 along with well, Castle, Dholavira



Fig. 6.28: Tank A, Castle, Dholavira

Even a cursory glance makes it obvious that it represents a masonry column by the side of the well. On the opposite side on the west too, there is noticed another pile although far smaller in size clearly due to the reason that it had been robbed much of its stone columns to support a horizontal wooden bar running right above across the well. That bar must have been fitted with a pulley for lowering a leather bag into the well for drawing water and letting it flow into the trough made of three stone slabs which is found on the south-eastern part of the well shaft.



Fig. 6.29: Tank B, Castle, Dholavira

The available evidence has strongly indicated that a large leather bag having two mouths, one wide and the other narrow, each fitted with a thicker and a thinner rope respectively, was used for drawing the water with aid of the above-mentioned pulley, etc. A group of persons or a pair of animals must have been drafted for pulling the ropes tied to the leather bag for drawing water from the well. Through that made of three stone slabs – one for the base having an outward slant and the two slabs placed vertically along the sides of the first one.

While the well-side of the trough is open-ended indeed, the opposite one is found blocked with a high masonry wall.

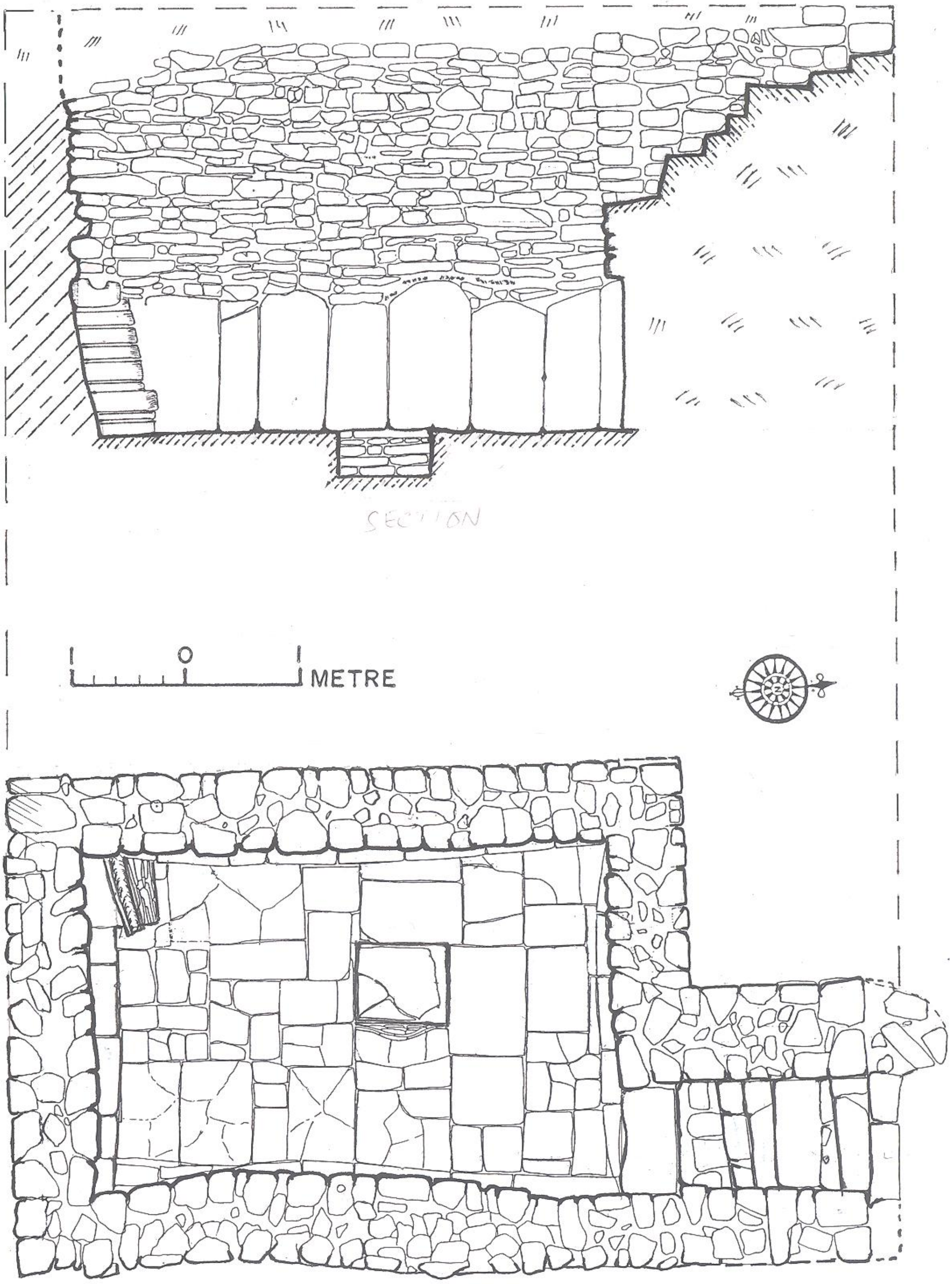


Fig. 6.30: Plan and Elevation of Tank 1, Castle, Dholavira

However, the south-western vertical slab has a small aperture that is connected to a covered drain that carried the water to two nearby water tank. As stated earlier, there have been exposed two tanks fed by the water drawn from the well. The larger of the two lies 9 m to the north and the smaller one 13.20 m to the north-east. Lying 4.70 m apart and placed parallel to each other, both are connected to a broad-way through their respective stairways. Internally, it measures 4.65 m north-south 70 cm wide, enclose the tank.

The stairway having six steps measures 2.25 m north-south and 2.50 m east-west. The steps having a span of 1 m and tread of 40 to 50 cm and riser from 20 to 40 cm, descend from the broad-way on the north (the 13 m wide broad-way running east-west divides the castle into two unequal halves). These steps have different phases of construction following the periodical rise in the levels of the broad-way over the Stages. Significantly, the stairs of the larger tank descend only halfway down and terminate 1.90 m above the floor of the tank. In the south-eastern corner, there is a spout projecting from the mouth of the drain that is connected to the well as stated above.

The maximum extant, may be the maximum original, height of the partly damaged walls of the tank is 3.80 m. The lower margin all around the tank is lined with limestone slabs, which measures large 60 to 70 cm wide and 1.20 to 1.30 m high. The slabs are joined together with fine, sticky and impervious clay. Above it there is found the rubble masonry of poor workmanship, which was raised from time to time due to the rise of the surrounding area.

In the centre of the tank, there is built a miniature tank having length, width and depth of 80 cm each. On the floor, there are deep use marks which can be caused only when one descends in the tank and makes use of the floor for grinding, polishing or pounding something. Howe and when that was done remains inexplicable. Some of the steps too bear circular depressions which are normally caused by placing water jars at a spot over a long period of time. Coming to the smaller tank we find that its internal measurements are: 2.20 m north-south; 2.30 m east-west; 4.85 m deep; and the staircase being 5.30 m long north-south and 2.45 m wide. The staircase has 14 steps descending from the

broad-way towards the south. Like that of the larger one, the span of the steps is one meter. Importantly, the stairs are far gentler and built much Better with an average tread of 30 cm. For stepping into the tank, a cylindrical limestone block is found placed on the floor near the stairway. It not only facilitated an easy descent but may have been also used as a seat by the user. We hold that this could be a bathing tank. Anyway, it is interesting to note that the cylindrical block conceals an aperture, which may have been connected to a drain for flushing out the used water.



Fig. 6.31: Well inside the Castle, Dholavira

The limestone slabs used for lining are smaller in height as well as width. However, the inlet channel showing a usually wide mouth. Like that of the larger one, is in the south-western corner. Floor paving is also of superior workmanship. A similar hole has been observed in the larger tank as well. In both the cases, there should be their respective drains connected to a sump or to the main drain that runs underground beneath the broad-way. Looking at both the tanks it is certain that the larger one was for the storage of water and the other could have been a bathing tank.

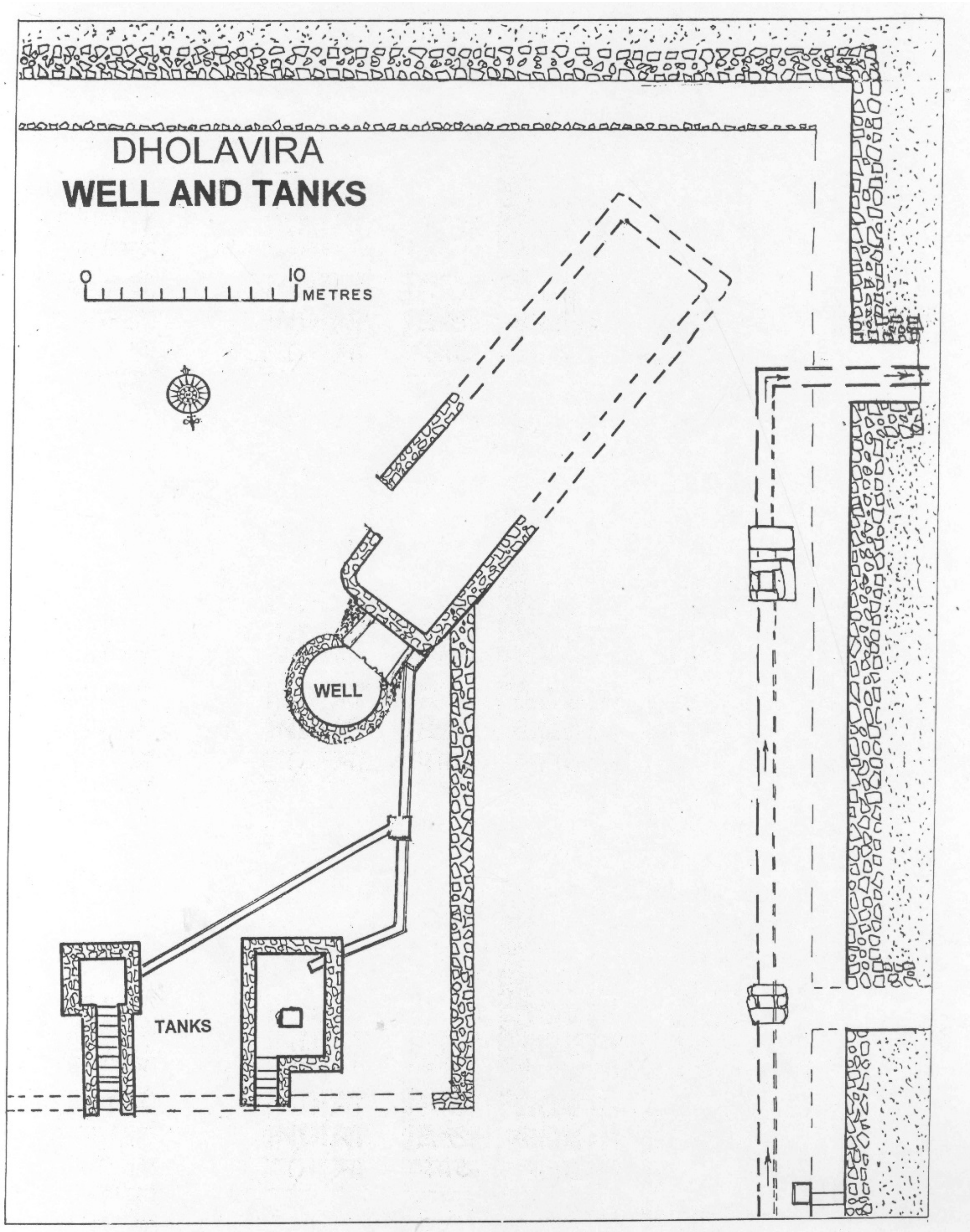


Fig. 6.32: Plan of the Tanks and Well along with drains, Castle, Dholavira

Most significantly, this water tank was found associated with symbolic evidence. A water jar, elegantly decorated with simple geometrical motifs in the Jhukar style, was found placed empty and upside down, with a stone lid on its

mouth, near the top landing of the staircase of the tank by the late Harappans at the time of desertion of the town of Dholavira. One well and two water tanks, which together make an integrated complex, have set an example of a kind. All those are located in the south-western quarter of the castle. On the north, it was bounded by the broad-way, on the south and west by the fortification and on the east, perhaps by the residential houses which yet remain to be probed.

All those water structures, as they were found and so far probed, were in use during Stages IV, V and VI. Further digging in this area may reveal a few more interesting features. Already, traces of some fire-places perhaps used for beating water have been observed. Besides, some small cubicle-like constructions which were once fitted with stone slabs were seen in the area lying between the well and the tank.

Those could be bathrooms. In the foregoing account, we have tried to recount the cultural progression, the highlights of planning and the freshly discovered system of water harvesting. Each one has added a new facet to the personality of the Harappa culture. It may be well rounded off by recapitulating about the gates and the stadia which too are marvels of planning and architecture.

6.7 Dams and Reservoirs

6.7.1 Dams

The kind of efficient system that the Harappans of Dholavira developed for utmost conservation harvesting and storage of water speaks eloquently for their advanced hydraulic engineering given the state of technology in the third millennium B.C.E. This concern for water also tells for the contemporary environment which may not have been glaringly different from what prevails now. The water must have been a precious commodity as of now. Seated on the margin of the monsoon belt, Kachchh experiences poor, often erratic summer precipitation.



Fig. 6.33: River Manhar with water during monsoon

Failure of monsoon, sometimes for consecutive years, is quite a phenomenon. There are no perennial rivers, lakes or springs. The ground water is, by and large, brackish and saline and unfit for human and animal consumption and even for cultivation largely. The winter rainfall is almost absent. Therefore, droughts are frequent and so are famines. On the whole, the environment is harsh and hostile to human existence. In such a ride Kachchh, the Khadir Island where Dholavira lies is the second poorest in rainfall which only averages to 262 mm per annum.

A good deal of forethought must have gone into selecting the site even for the first settlement which was by far a fortalice only. The early Harappan chose a higher ground by the side of the Manhar, one can see that an (or rather the) inundation channel, if not the main channel itself, was flowing in the east and then running along the south of the site of the first settlement.



Fig. 6.34: River Manhar with traces of dam

The first settlers who had developed expertise in Baluchistan and Sindhi Kohistan before coming to Kachchh may have successfully dammed the Manhar and deepened its bed by cutting the basal rock in order to carve out a large reservoir spreading over in the east as well as the south of their fortress. Perhaps, the aberrantly cut deep tank, a lower part of what can see inside the subsequent rock-cut reservoir to the south of the castle, if the remnant of the first experiment. Surely, the selection of such a site beside a smaller torrent having potential of being tamed was a well-considered decision.



Fig. 6.35: River Manhar with remains of dam

Otherwise, there were existing many a deeper and broader channels having voluminous flood regime but those were certainly too difficult for harvesting water as the builders did not possess the knowledge of raising durable dams for want of dependable cementing material. This choice of site naturally suited well to all the successive Harappans who gradually developed it into a town and then a city. Given a slopping nature of a wider ingeniously encompassed all the principal divisions of the expanded settlement. In order to harvest more water, they reached out to the Mansar which too was dammed for filling the reservoirs. In fact, the Manhar has evidenced for three and the Mansar for two places where the dams were raised across their channels. At the prospective site of the lowermost dam, thrown across the Manhar, there were exposed lower remnants of several closely adjoining parallel walls in the river–bed by simply removing the sand accumulated over them. Nearby and further down-stream, a scatter of huge stone blocks of different geological formations other than those found in the vicinity may be seen lying helter-skelter in the bed. Those blocks, some of them cut to size, are too heavy for being transported over distance by the flood waters of the channel. Similar situation prevails at the other dam sites too. Close to the lowermost dam site across the Manhar, an enormous bounding wall with a neatly plastered face and having an inlet channel higher up for letting surplus of the dammed-up water into the southern series of the reservoirs was laid bare. The deposit accumulated on the other side of the inlet channel vividly showed the angle and depth of fall as well as the force of water.

6.7.2 Reservoirs

The Harappans during their heyday created within the city walls in all sixteen for more reservoirs of varying sizes and arranged them, along the northern and western and largely along the southern sides of the main settlement and the east of the citadel.

A gradient of 13 m lying between the higher north-east and the lower southwest was ideally suited in selected tanks instead of letting it spread out over larger area as a thin sheet which should be highly susceptible to quick evaporation and seepage. Many of the reservoirs might not be meant for storing water all the year round as they were carved out by removing the top soil down to

the bed-rock which does not behave evenly nor leis adequately deep all over. Possibly, to get all the reservoirs filled with repairs to private houses and public structures as soon as the rainy season was over; secondly for the irrigating summer crop; and if not the least, to enrich the ground water reserve.

In the whole scheme, the city walls, particularly on the west and its adjoining quarters, played a crucial role. Apart from providing formidable protection to the city, they functioned as strong bunds made of millions of moulded mud-bricks carefully laid in mud mortar. The inner peripheral road lined with stone masonry saved the walls from the water scoring as well. A tentative estimate indicates that the reservoirs account for about 10 hectares, working out approximately to 10% of the total area covered under the city. Our earlier view that the north-eastern quarter across the Manhar housed a large reservoir was not substantiated by the sporadic digs that were made there.

Recent excavation has brought to light to excellent examples of reservoirs. The east reservoir is the largest, grandest and best-furnished one in the series that Dholavira has yielded so far. It was carved out under the shadow of the imposing castle that stands 20 to 22 in west while it is bounded by the little stadium on the north. Now, all of its four corners stand duly ascertained and fully exposed. All the four walls of the basin bear outward slope from the bottom upward. Running north-south, parallel to the eastern arm of the castle wall, the longer axis of the reservoir measuring 73.40 m to 73.50 m at the extant top and approximately 70 m at the bottom and the width at the top and the bottom are 29.30 m and 27.70 m to 27.75 m respectively, while the general depth does 7.50 m to 7.20 m from the mean surface level of the modern cultivated field. Perhaps, the height of the stone-made side wall of the reservoir should have been 7 m to 7.50 m including the 1.00 m to 1.20 m high embankment made of rubble.

The ratio in respect of depth, width and length works out to 1:4:10, while that between the length and the width, whether upper of lower, is 2:5. In other words, the length was two-and-half times the width and the depth was $1/10^{th}$ of the length, in other words it was $1/4^{th}$ of the width. It is significant to note that the maximum depth that was obtained by cutting the rock has measured to be 10.60

m in the northern part of the reservoir where probing is done limitedly. Not unlikely that the greater part of the reservoir in its central zone was deepened to the said depth of 10.60 m while the margins along all four sides were kept higher having two levels. In its present form the reservoir may be a creation of Stage IV itself.

There are, however, indications that the earlier ones, albeit of lesser pretensions in terms of size, shape and depth may have been there perhaps all the time right from the beginning of the first settlement itself. There was surely one during Stage III. Among the other components of the east reservoir, the most significant ones are: the three flights of steps; a rock cut well within a walled enclosure; the smaller and deeper basin cut out of the rock; some other enigmatic and minor features which may have been introduced at different points of time for some special short-lived uses.

In the cultivated fields lying between the castle on the north and the annexe and the city wall on the south, there were buried a series of five reservoirs. These are of varying sizes and orientations excavated into the soft sedimentary formation of sandy limestone. The reservoirs were not arranged in a straight line precisely. Their disposition is rather staggered and can be divided into three sub-units: The first two reservoirs from the east are designated as South reservoirs I and 2 (SR-1 and SR-2 in abbreviated forms respectively), the third one consisting of another two reservoirs in the west SR-4 and SR-5 and the second subunit, i.e. SR-3 occupies the central location between the two subunits and was the first to come to light, and, also, perhaps to have been excavated first among the southern ones. The first reservoir internally measures 30.35 m E-W and 13.90 m N-S with a depth varying in general from 3.90 to 4.20 m while the second is 9.60 m N-W and 4.45 m E-W.

The third one which is centrally located is primarily a rock-cut architecture of excellence, exquisite beauty and superb skill (fig. 5). The excavation has revealed that it consisted of some underground features and some over ground appurtenances. Among the former, there are: a deep basin, a deeper trough, a free-board, two masonry flights of steps and a covered rock cut outlet channel. In

the later category there are: an enclosure wall and an outlying working platform, a massive levee with inlet drains, and a passageway flanked by walls, an ascending flight of steps leading to a covered passageway that was pierced through the defensive wall of the castle. Running almost parallel to the defensive walls of the castle as well as the city, the rock cut reservoir was outlined into a rectangle measuring 33.40 m east-west and 8.90 m to 9.45 m north-south while its bottom had two different levels: the lower one at the depth of 7.90 m from the ancient working surface (8.36 m below from the presently prevailing one); and the upper being at 5.90 m to 6.50 m. In fact, the deeper level pertains to the through that was cut into the eastern half of the basin of the reservoir. It has measured 15.50 m long and 5.65 m broad but oriented, most significantly, oblique to the sides of the main basin at a deviation of 14º.

The remaining two were oriented somewhat differently from the rest of the reservoirs while both are rock-cut ones. The east-west length of the fourth reservoir's northern wall measures 11.40 m while its southern counterpart is about a meter less, say 10.34 m. On the eastern-side the width measures 7.10 m, whereas on the west, it is 7.10 m, whereas on the west, it is 7.95 m. The fifth reservoir measured 16.35 m along east-west on the south and 11.10 m north-south along the eastern side, was largely and, perhaps, intentionally left unfinished with an end-to-end meandering depression along its southern side. The shallower part of the reservoir measured 3.40 m and deeper area went down to 3.40 m.

6.7.3 Storm water drainage

The citadel has yielded an interesting network of drains, both small and large, coming from different areas, and ultimately connected to an arterial drain that runs underground in the broad-way (fig. 10). The larger ones are high and broad enough to allow a person to walk through them easily. All these drains are usually found containing fresh water deposits, and not sewage nor household waste, nor are these connected to house drains. It was only during Stage VI that a house drain seems to be discharging in to one of the storm water drains, when those had already become defunct. The purpose of these drains was surely to let out the monsoon run-off.



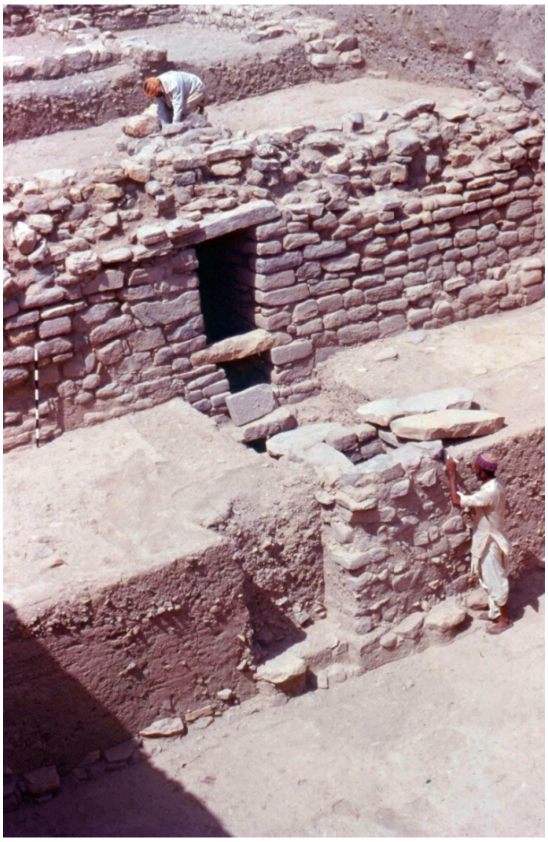


Fig. 6.36: Storm water drainage in Castle, Dholavira

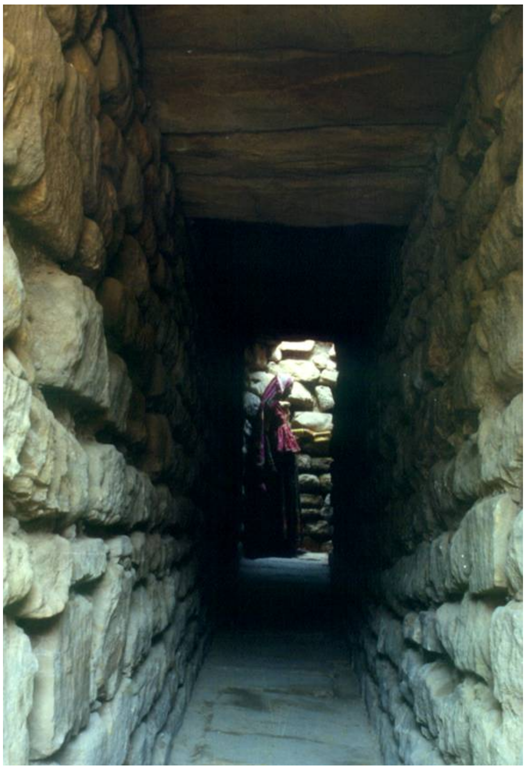


Fig. 6.37: Interior of drain, Castle



Fig. 6.38: Manhole, Castle



Fig. 6.39: Exit of drain in castle



Fig. 6.40: Drain towards the Bailey



Fig. 6.41: Drainage pattern in Ceremonial Ground



Fig. 6.42: Example of stone cut drains



Fig. 6.43: Example of terracotta pipe drains

Which is why these are found furnished with air ducts at short intervals. There are two large drains in the castle. One originates from the salient beside the east gate and the other from the area close to the north gate (fig 11). The former is connected to a stone-paved platform provided a top the eastern fortification wall near the east gate. The rainwater falling on the top of that part of the wall may have been collected there from where, through a beautifully cut-stone cascade, it flowed into a covered drain running under the broad-way of the castle.

Running towards the west, the drain meets somewhere near the centre with another principal drain which is found, in turn, to be issuing from two interconnected chambers made of stone. The clay deposit in the chambers was found thoroughly churned up as if under the force of water falling from a height. There was apparently no source of water. To explain it, it may be added that there runs a pathway between these chambers on one side and the northern castle wall on the other. There have been laid bare stupas of four brick-made columns: two of those columns are found abutting the fort wall while the other two are attached to the above-mentioned twin chambers.

It is postulated that these columns supported conduits made of pottery, wood or stone to conduct the rainwater falling on the top of the nearby north gate as well as the adjoining fortification wall and letting it fall with a force into the chamber (s) down below from where it flowed into the large covered drain. To that, another drain, having its head in the form of steps at a short distance away in the east, met the former drain nearly halfway down. The combined water of these two drains joined that was the flowing in the arterial drain coming from the eastern wall. Before that the water, hereto, flowed down a cascade. On its westward march, the arterial drain running all through under the broad-way hit the side wall of the stepped pathway near the west gate and then turned at a right angle to take a southerly course. Some distance short of the south-western corner of the castle, it again took a right-angled turn to pierce through the western castle wall. Before that, just at the turn, it was met with another covered drain coming from the east. The united water of all the drains was then falling through another cascade into the drain down below running in the bailey, which finally carried the rainwater into a kutcha reservoir that was carved out in the western part of the bailey itself.

All the drains were made, carefully with smooth floors, sidewalls, capstones for roofing and air ducts at intervals. If a small segment of a principal drain did yield some doubtful material, it offered cult images and objects. In fact, one or two of its apertures remained exposed during Stage VI definitely and in Stage VII possibly. Any abuse was not at all impossible. It must also be borne in mind that none of the drains of the network was found connected to domestic houses right up to Stage V.

So far disposal of the household waste is concerned, the middle town, the lower town and the annexe have presented the evidence of sanitary jars or stone-made sanitary tanks placed or provided on the streets.

6.8 Water management System / Reservoirs

The Harappans of Dholavira had developed such an efficient system for conservation, harvesting and storage of water that speaks eloquently of their advanced hydraulic engineering given the state of technology in the third

millennium BC. Their concern for water also perhaps points towards the contemporary environment, which may not have been much different from what prevails now. The water must have been a precious commodity as of now. Seated on the margin of the monsoon belt, the region of Kachchh, which now prides on Dholavira, experiences poor, often erratic summer precipitation. Failure of monsoon, sometimes for consecutive years, is quite a phenomenon. There are no perennial rivers, lakes or springs. The ground water is, by and large, brackish and saline and unfit for human and animal consumption and even for cultivation largely. The winter rainfall is almost absent. On the whole, the environment is harsh and hostile to human existence. And, the Khadir island, which is located in the middle of the Rann of Kachchh and where the ancient site of Dholavira is located, is the second poorest in the arid Kachchh, so far is concerned the rainfall which only averages to 262 mm per annum.

The early Harappans chose a higher ground by the side of a monsoon torrent namely Manhar. One can see that an (or rather then) inundation channel, if not the main channel itself, was flowing in from the east and then running along the south of the prospective site of the first settlement. The first settlers who had developed the expertise in Baluchistan and Sindhi Kohistan before coming to Kachchh may have successfully dammed the Manhar and deepened its bed by cutting the basal rock in order to carve out a large reservoir spreading over in the east as well as the south of their fortress. Surely, the selection of such a site beside a smaller torrent having potential of being tamed was a well-considered decision. Otherwise, there did exist in Khadir many deeper and broader channels having voluminous flood regime. But it should have been certainly too difficult for the builders to harvest water from those channels as they did not possess the knowledge of raising durable dams for want of dependable cementing material. The choice of the present site naturally suited well to all the successive Harappans who gradually developed it into a town and then a city surrounded by an impressive array of reservoirs. Later, in order to harvest more water, they reached out to another monsoon channel called the Mansar that runs roughly east-west along the north of the site. That too was dammed for filling the reservoirs. In fact, the Manhar has provided evidence of three dams and the

Mansar of two. These dams were raised across these channels. At the site of the third dam across the Manhar, there were exposed remnants of several closely adjoining parallel walls in the river bed by simply removing the sand accumulated over them.

Nearby and further downstream, a scatter of huge stone blocks of different geological formations other than those found in the vicinity may be seen still lying helter-skelter in the bed. Those blocks, some of them cut to size, are too heavy for being transported over there by the floodwaters of the channel. Similar situation prevails at the other dam sites too. Close to the third across the Manhar, there is unearthed an enormous wall with a neatly plastered face and an inlet channel at the upper end for letting the surplus water into the southern series of the reservoirs. The deposit accumulated on the other side of the inlet channel has vividly showed the steeply slanting strata brought by the gushing waters.

The excavation, particularly in the east, i.e. to the east of the Harappan castle and to the south of the lower town, has amply shown artificial removal of an enormous, 3.50 m thick, pile of alluvium to make room for a reservoir as the pottery of different "stages" have been collected from the later fill. The pottery of Stages I and II has, in fact, been found still sticking to the underlying bedrock while those of the later stages were lying embedded at different levels of the subsequent water-borne deposit. The said deposit contained potsherds of all Stages right form I to VI and even VII in the order of stratigraphic sequence from the bedrock upwards. As late as in Stage VI, the people attempted to raise a check-dam over the accumulated river debris. Looking at the depth of 3.5 m in the eastern zone against the depth of 8 m or even more of the westernmost reservoir of the eastern series, one can visualize the existence of a descending cascade of reservoirs. Many of them are still awaiting the archaeologist's spade.

Before coming to the details of two excellent reservoirs it would be proper to state in general about the system. The Harappans, during their heyday, created within the city walls in all sixteen or more reservoirs of varying sizes and arranged them, along the northern and western and largely along the southern

sides of the main settlement and to the east of the citadel. The gradient of 13 m lying between the higher northeast and the lower southwest was ideally suited for carving out a series of reservoirs along all those sides in a cascading manner. Those were separated from each other by broad bunds made of earth or mud-bricks faced with stones. Looking at the high gradient of the land surface as well as the water dynamics, it was imperative.

These several bunds / embankments helped carve out as many water bodies and individually each of them effectively reduced the water thrust on one side and facilitated movement of the people, animals and goods between the city divisions and the countryside. In a good monsoon year, all the reservoirs could have been full of water. But, in a lean year, the water may have been stored in selected tanks instead of letting it spread out thinly over a larger area and get quickly disappear due to evaporation and seepage.

Many of the reservoirs might not have been meant for storing water all the year round as they were carved out quite shallow by removing the top soil from the bedrock which at several places or zones is undulating and not deep enough all over. Possibly, storing of maximum volume of water served multiple purposes: firstly, to utilize it for large-scale repairs to private houses and public structures as soon as the rainy season was over; secondly, for irrigating summer crops; and lastly, if not the least, to enrich the ground water reserve. In the whole scheme, the city walls, particularly on the west and its adjoining quarters, played a crucial role. Apart from providing formidable protection to the city, they functioned as strong embankments made of billions of moulded mud-bricks carefully laid in mud mortar.

The inner peripheral road lined with masonry saved the walls from the scoring action of the water as well. A tentative estimate indicates that, out of the total area of about 49 hectares on which the Harappan city stood during its heyday, the reservoirs account for about 10 hectares, not perhaps 17 hectares as surmised earlier. This works out approximately 20% of the total area of the city that was used for the water storage. Our earlier view that the north-eastern quarter across the Manhar housed a large reservoir could not be substantiated by

the sporadic digs that were made there later. The recent excavation has brought to light two excellent examples of reservoirs. One of them lies astride to the east of the castle and alongside the southern enclosure wall of the smaller stadium. The other one is the earliest ever rock-cut example that too on a grand scale. It lay along and in between the castle and the annexe.

6.8.1 East reservoir

The reservoir has been unearthed at some distance to the east of the eastern castle wall and a few meters away from the southern enclosure wall of the little stadium.



Fig. 6.44: East Reservoir, Dholavira

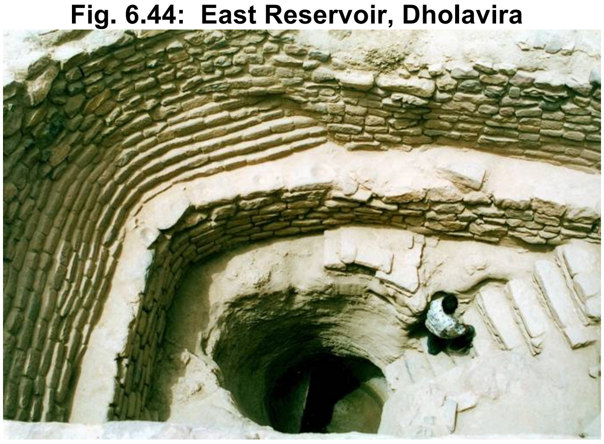


Fig. 6.45: Step well inside East Reservoir



Fig. 6.46: Details of step well and eastern arm of East Reservoir, Dholavira

In a 10 m wide cutting along north-south, it has been exposed to its full width of over 26 m along east-west whereas the third corner, lying in the southeast, has been confirmed at a distance of 73 m from the north-eastern corner. A flight of 30 steps abutting the northern embankment starts from the west that is the side of the castle, and descends to the bedrock that was struck at

a depth of 8 m from the level of the cultivated field. The faces of all the three embankments, which are eastern, northern and western, have shown a marked downward taper. The masonry is of superior workmanship.

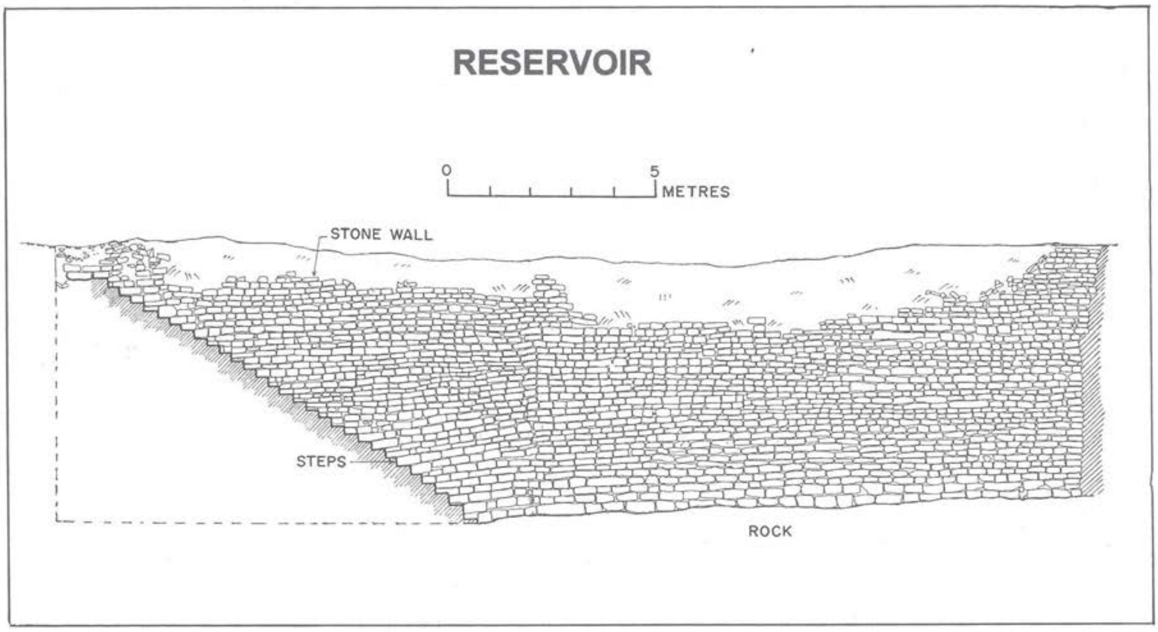


Fig. 6.47: Elevation of eastern arm of East Reservoir, Dholavira

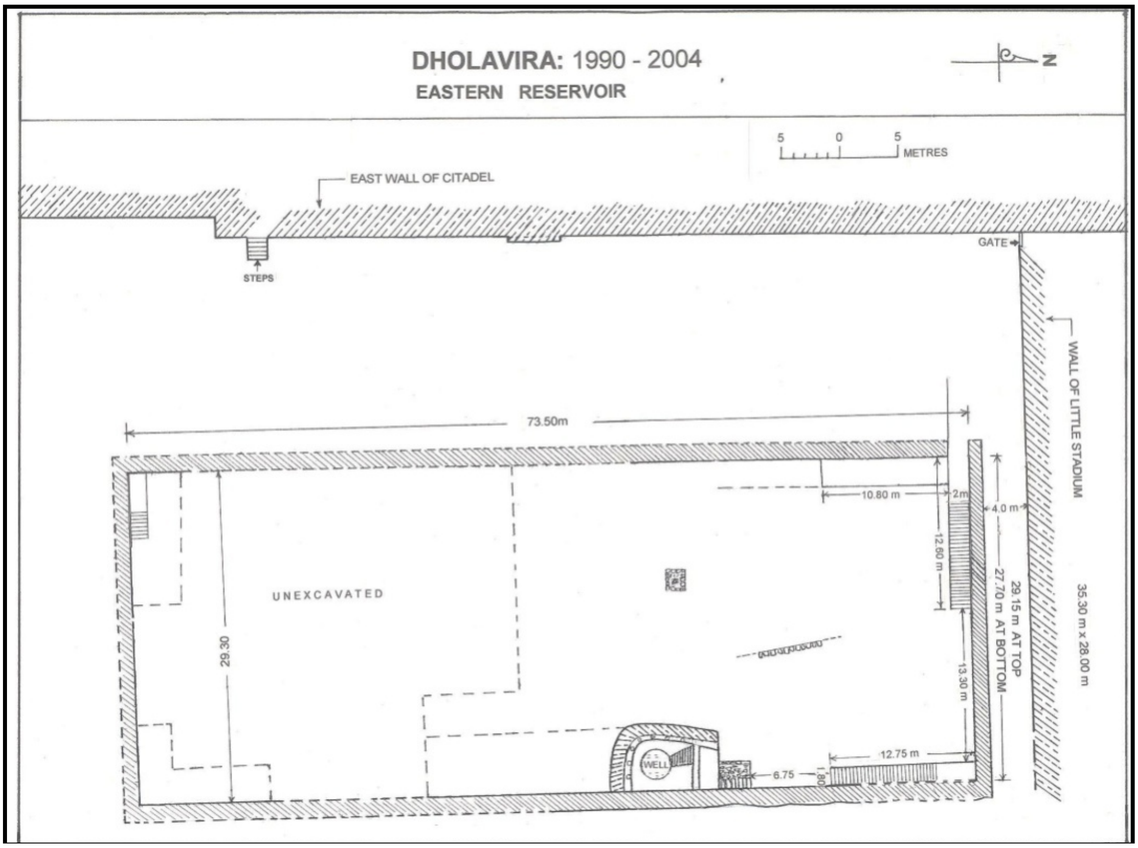


Fig. 6.48: Plan of East Reservoir, Dholavira

The castle-ward embankment has indicated that it was built in segments so that the entire bank should not collapse or suffer in an adverse situation of intensity as such structures should be always vulnerable due to the presence of water and the absence of some durable cementing material for the mortar. The northern one seems to have suffered intermittently as can be judged from the changes in the construction. At least once, it caved in extensively but was duly repaired during Stage IV. In fact, the reservoir in its present form is a creation of Stage IV itself although it is our belief that an important reservoir of pretensions should have been there all the time right from the beginning of the first settlement itself. There are some clues to it. While probing in a small dig that was cut into the damaged part of the northern embankment, we have notice that it was repaired with a mixture of sticky clay mixed with stone pieces and pottery, which rested upon a pile of sand, which, in turn, overlay a sticky impervious clay deposit the kind of which is normally found as a geological formation or as the topmost layer of the sediments that accumulate in an artificial lake as the clay is an ingredient in the local earth itself. The clay was analysed by Ajanta Sachan of IIT Gandhinagar who concludes that it contain monmorillonite as major constituent, which is responsible for impervious nature of this material. Keeping the interpretation pending for the time being, we refer to another piece of evidence that was found near the south-eastern corner tower of the castle

While excavating outside the said tower, there was found an enormous construction of mud-bricks. Further down, there were found two massive mud-brick walls abutting each other and running roughly along the east-west orientation, but somewhat different from that of the east-west running castle wall of stage IV onwards. On digging deep beside the northern (inner) side of the conjoint walls, there was found the promiscuous deposit of the same sticky clay mixed with the profusion of stones and pottery. Having no idea of what we were going to find in the close proximity we stopped the work as the field season too was coming to a close. With hindsight, it may now be connected to the embankment building activity of the east reservoir as those are seen now. Here, it may also be recorded that further northward, there was encountered a rocky formation underlying the archaeological strata.

By piecing together the titbits of evidence, it may be surmised that there existed a natural depression where now the east reservoir exists. The flood water of the Manhar could have easily filled it up regularly as even today the surplus water of the stream flows into this area and then moves on to the south of the castle. This phenomenon of a natural depression having promise of holding water might have attracted the first settlers to have their fortress-like habitation at Dholavira. While deepening it or creating a pukka reservoir by the (later) occupants, the clay deposit from beneath the places of upcoming embankments seem to have been left undisturbed, or else what was found beneath the northern embankment was dumped first before the construction was undertaken.

The former postulate appears to be closer to the truth. Significantly, the southern arm of the smaller stadium wall, made of thin stone and plastered with the white and pink clays, surely belonging to Stage III, was found abutted with the northern embankment of the east reservoir. Since the facial plaster of the stadium wall was found nicely intact and buried behind the later embankment, it is certain that it stood free above the ground and its contemporary reservoir, if any, must be lying some distance away. And, the two conjoined, massive mud-brick walls exposed near the south-eastern corner of the castle could have been the embankment or a part thereof of Stages II and III. Importantly again, the Harappans of Stage IV seem to have raised the embankment(s) of the reservoir as those are seen today. A part of the eastern embankment that could be studied so far has shown that it was first made of mud-bricks as a massive construction and then veneered with stonework. The treatment should have been the same on the other face as well. That side is not exposed as yet. In fact, even the width of the embankment still remains to be ascertained.

There are other observations, which need to be recorded. A margin of bedrock along the northern as the eastern sidewall was kept higher than the rest. Perhaps the condition of the rock on the western side may have been different. Therefore, the builders raised a terrace like stonework right upon the floor of the reservoir along the western side so far as it has been exposed. Furthermore, it may be mentioned that the people descending through the stairs into the reservoir were quite regularly moving toward the centre for fetching water and

thereby caused considerable wear and tear to the rock in that direction as they did to the steps of the flight too. As result, it became necessary to place some stone blocks beside the lowermost step for an easy descent later on. In these circumstances, our earlier presumption that a part of the bedrock might be excavated down to the water table for ensuring regular water supply all the year round and even during the drought year(s) might not be off the mark. In fact, it is being vouched for perhaps. Because a part of the bedrock floor has started going further down by 2.5 m and, in the process, the depth of the reservoir that has been attained so far now measures 10.50 m from top level plain and that feature was still continuing up till the close of the work for the last field season.

Sometime during Stage V, the gushing waters broke into the reservoir after demolishing the eastern embankment to a great length and a greater depth. As a result, the other embankments, particularly the western one and part of the stairway and the northern embankment did suffer considerable damage. In the same process, almost the lower half of the reservoir got filled up with the collapsed debris of the embankments as well as the sediments brought in by the food water, and the area became as a level ground which was then used by the Harappans of Stage V for miscellaneous purposes. Their activities are represented by fireplaces, kilns and so on carried out during the later part of Stage V. Even during Stage VI, the available land surface was being used for similar activities. During Stage VII, some structures were raised close to the enclosure walls of the castle as well as the stadium and the feeble traces were noticed on the surface. Naturally, the reservoir ceased to be a water structure. All the other reservoirs of the eastern series must have met with the same inevitable fate.

This situation has amply demonstrated that by the middle of Stage V which is the stage of decadence during the last phase of the mature or classical period, the Harappan had been so weak economically that they did not have enough resources to make the reservoirs, at least those of the eastern series, to be functional any longer. Secondly, the east reservoir might be enjoyed some religious sanctity that is why the Harappan were assembling there occasionally for celebration and evidence for it is in the form of a number of fireplaces and the

broken pottery, over successive strata, but no regular and continuous occupation or occupational debris.

6.8.2 Southern (rock-cut) reservoir

In the cultivated field running to the south of yet alongside the castle, there has been brought to light an east-west oriented rock-cut reservoir, the first of its kind in the Harappan, for that matter, in any pre-historic context found so far. This reservoir seems to be running parallel to the castle wall on one side and to the southern city wall on the other. It is in a stepped fashion having three levels cut through the sandy limestone formation. The bottom of the reservoir was struck at a depth of 8.36 m below the surface and 7.90 m below the ancient working level of Stage III during which it was first excavated by the Harappans. In fact, the first step that was partly cut through the rock and partly built up in the gaps of the rock was carved to obtain a landing terrace running along on either side of the reservoir.

In width, the northern landing measures about 4 m and the southern one about 2 m wide at the eastern end and goes on widening towards the west to become 4.20 m near the western end as has been exposed so far. Similarly, the southern terrace too increases in width from 1.50 m to 2 m from east to west. The span of the reservoir at the top of the ancient working level measures 15 m while the vertical cut of the northern terrace through the rock is 65 m and that of its counterpart on the other side is 45 cm. In the same way, the width of the main reservoir, meant for holding the water, varies from 8.70 m to 8.90 m from east to west. Either face of the reservoir has a mild batter. As a result its width is reduced by about 50 cm at the top of the second level as was obtained at the depth of 3.43 m on the north and 3.35 m on the south. Significantly, the eastern end of the reservoir is excavated deeper as a trough which runs obliquely at an angle of 14? On both sides from the orientation of the former; it is 15.50 m long and 5.65 m across with the depth of 2 m on the north and 1.40 m on the south. Further, length-wise side at the north-western as well as the south-eastern corner is flush with the corresponding vertical face of the reservoir.



Fig. 6.49: South Reservoir 3, Dholavira



Fig. 6.50: Section across the South Reservoir, Dholavira



Fig. 6.51: South Reservoir 2, Dholavira



Fig. 6.52: South Reservoir 4, Dholavira



Fig. 6.53: Staircases between South Reservoirs 3 and 4



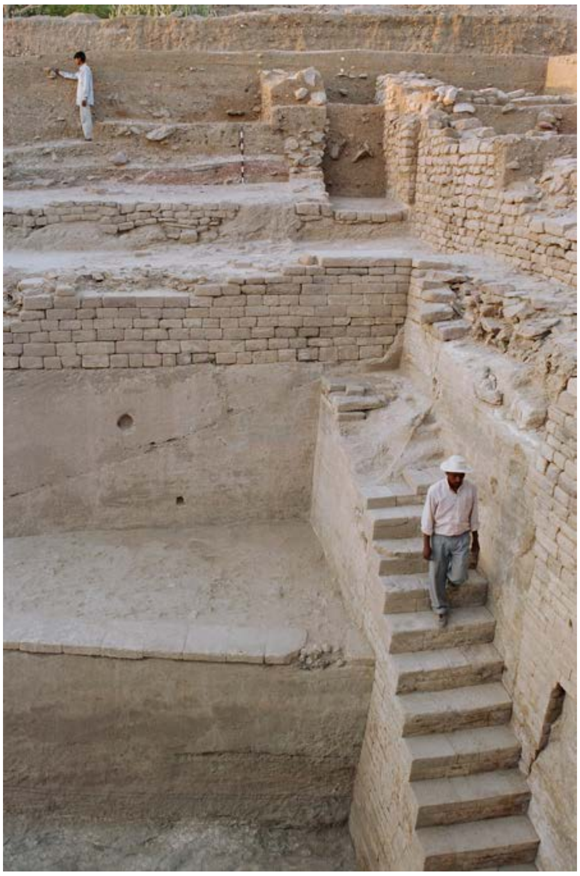


Fig. 6.54: Ramp near South Reservoir 4 (left) and Fig. 6.55: Staircase inside South Reservoir 3



Fig. 6.56: South Reservoir 5 and view of spill channel

The only plausible explanation that we could seek is that it was to facilitate to lower with the help of a rope a leather bag, an earthen jar, or a wooden bucket for drawing water from that deep trough. It is, however, pertinent to mention here that the north-western corner is directly below that area which has revealed a flight of steps going up the slope to lead to a gate opening which, in turn, is connected to a long passageway pierced through the thickness of the southern arm of the castle wall. We prefer to call it a Watergate, which may have been used by the members of the royal household and their menials during Stages III and IV or seven V before it was filled in and blocked sometime in the last mentioned stage. While reverting to the other side of the south-eastern corner of the trough, it may be informed that the houses of the annexe that lay along the southern city wall stood a few paces away.

Interestingly, piercing through that wall, there has been exposed a narrow and surprisingly an oblique gate, which, on the other side, opened on to another walled enclosure lying outside yet attached to the city wall. It is postulated that enclosed area could have been the royal ranch. Furthermore, the excavation in the area that intervenes between the annexe and the reservoir has yielded several large troughs made of white and pink clays, which could have been used for keeping water for various purposes including for the beasts of the royal ranch. In fact, a stone-lined pathway, a part of which came up through excavation, perhaps ran between the above-mentioned gate and the reservoir.

Chapter 7

Pottery

7.1 Introduction

Chrono-culturally and broadly, the ceramic industry of Dholavira can be classified into the following four major groups:

Group 1. Stages I to III

Group 2. Stages IV and V

Group 3. Stage-VI

Group 4. Stage VII

Each group is marked by a wide variety of wares, types and surface treatment. One thing that is remarkable is that there are many essential forms, wares and technological finesse which to put together would became the classical examples of almost universal adoption and distribution along with their wherewithal over the centuries during when Harappan Civilization reigned supreme for example, the dish-on-stand, dish, basin, perforated jar and soon along with some necessary objects like triangular cakes, fortification etc. are present right from the beginning. This is why it is rightly believed that Dholavira has emphatically demonstrated as of how the Harappan civilization had its roots in a unidirectional and progressive growth.

Coming to the minutiae of the ceramic technology, typology and decoration, there are two streams: one progress into the Harappan standards and the other which is different and continues concomitant all through with its own history of continuity as well as change, both of which may make subject of in-depth study by scholars in future. The third group belongs to stage VI and the distinct feature of this phase is the white painted black and red ware (BRW). The pottery of this stage yielded the remains of small sized vases, bowls etc. the classical pottery also

continue in this stage but some gradual decline noticed in fabric and surface treatment. The classical goblet of earlier stages changes its shape and converts into small globular vase with a goblet like stand.

As indicated above about different ceramics present from the beginning of Stage I, the sturdy red ware of well-levigated clay, assured hand in shaping on a Fast wheel, applying pleasing and well applied slip with occasional decoration on types destined to be the ones of the Harappan repertoire are duly present. It compares well in technique, colour and form with the pottery group context A from the lowermost layer of the deep cutting at the citadel of Mohenjo-daro by wheeler in 1950 but described later by Leslie Alcock (Alcock 1986, 502-15). Significantly, that pottery was exhumed from the Groundwater locked strata which never be excavated fully to the natural level due to the collapse of the cutting by the underscoring water. Now Dholavira has stopped to give it a fillip that has been a want of such a conviction from any excavation elsewhere. Although Nausharo in Kachi Plain in Baluchistan where its period I is comparable in some details with the Stage I-III at Dholavira. In terms of time and cultural make-up, the next the so-called reserved slipped ware (RSW), which is an essential cultural accompaniment of the Harappan culture in the whole of Gujarat whereas elsewhere it is absent but for a few sherds which came-up from the lower level of Mohenjo-daro. In Gujarat, it appears to have attained the status of deluxe pottery, only next to the classical one. This RSW has its beginning in Stage I and it never went out of vogue ever thereafter. Rather, it became finest during the mature phase. The RSW is represented by the classical bluish grey examples, which was a resultant of reduced firing conditions and also by the reddish orange examples, which was due to partial re-oxidation.

Among the other, miscellaneous ceramics are red, buff and grey ware all of which largely look towards Sindhi Kohistan and Baluchistan in from and spirit. For example, use of white pigment in its diverse combination with black and purple over a slip that range from deep chocolate to red colour has its source of inspiration in

the north-west and the same may be said about its use in the Sothi wares of north Rajasthan, Punjab and Haryana although it assumes an altogether different treatment.

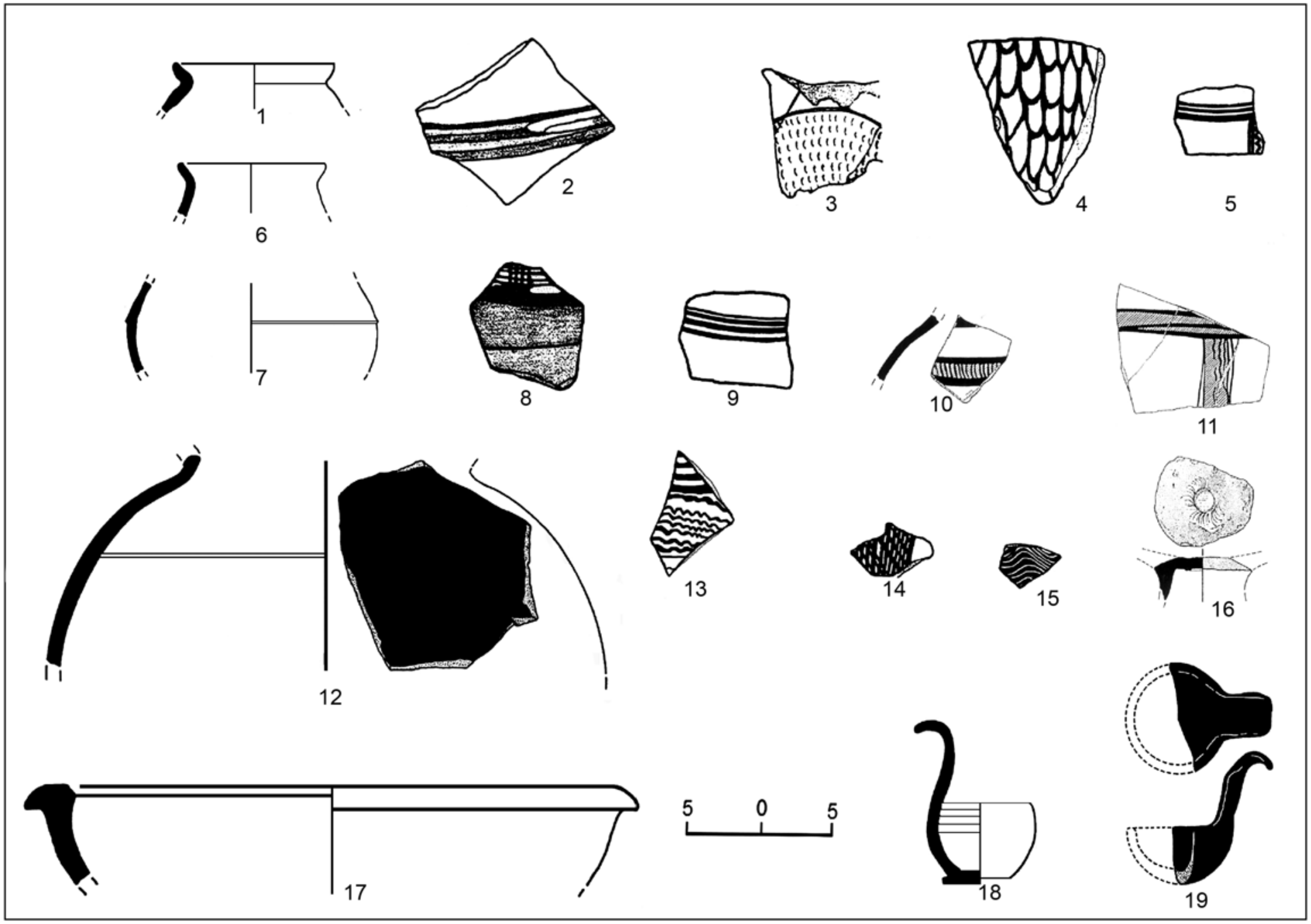
Coming to the Classical phase of the civilization which is represent by the milieu of Stage IV and V, all standard shapes and sizes along with their surface treatment, decoration or without it appears in the fullest glory. It is however interesting the classical ceramics make two groups: which is the standard ware; and the second the regional ware, peculiar to Dholavira, rather Kachchh and even Gujarat. In both, all basic/ common forms such as dish-on-stand, dish, perforated jar, S-shaped jar, goblets, beaker, bowl, bowl cum-basin, basin etc. appear along with their variants together with their miniature forms. The same is the case with the presence or absence of slip of all hues and quality over the surface, which is in cases decorated with the classical painted motifs executed in all manners ranging from being most careful and aesthetic to carefree and casual.

The Stage VI, which appears at the site after a phase of desertion, is equally significant in that it, not only brought out many changes of for reaching consequence in planning, architecture, sigillography as well as in quantum shift economic structure, but also witnessed feverish commingling of communities from north to south and east to west. This is best reflected in its ceramic assemblage as well. While the classical and sub-classical Harappan ceramics together with its accompanying coarse fine wares of the preceding Stage continued, of course, with same perceptible changes, there appear an assortment of potteries such as the while painted black-and-red (B&R), black and grey ware along with their plain types, the Jhukar style pottery with bichrome decoration, Cemetery H-Bara pottery types and the stud-handled bowls strangely, the first category of pottery which was always associated with the classical Harappan assemblage at Lothal and other places nearly about at Dholavira same for these sherds coming from different stratigraphical context.

So for as the ultimate phase of Stage VII is considered all Harappan forms and decoration together with planning and architecture, seal, sealings, weights,, etc. became conspicuous by their absence and ruralism takes over. The thin fabrics of red and grey wares, which continued at the site from Stage I onwards, became the norm of the assemblage. It may be relevant to record that this stage has not left behind any horizontally distributed occupational deposit at the site. Its relics could be collected limitedly from within and without their circular structures of stone, which surely served as the base for superstructure of wattle and daub usually with a column for supporting a conical roof.

Stage VII or group IV a few sherds are found inside the circular structure or scattered close by.

Pottery that is found in Stage I to III are red, largely pinkish red ware, reserve slipped, ringing grey (of perhaps Faiz Mohammad grey ware genes), kaolin / white wares, both plain and slipped, slip has a wide range in colour such as red, buff, black, chocolate, violet purple and grey. Pigments used for painting are red, black, purple, buff and white. There are examples in which there interplay of colours namely black, red and white during the classical phases represented by Stage IV and V, while the pre-existing ceramic traditions continue.



Pottery from Stage I: 1, 6: Red ware pots (simple, external projecting and everted rims, globular or bulbous body), 2, 4, 5, 8, 9, 10, 11,13-15: Non-diagnostic painted sherds (geometric and naturalistic deigns like parallel and wavy lines, loops etc), 3: dish-on-stand (broken central portion with concentric incised decorations),16: dish-on-stand (broken middle potion), 17: dish (with small beaked rim), 18-19: handled bowl (concave sided with simple featureless rim)

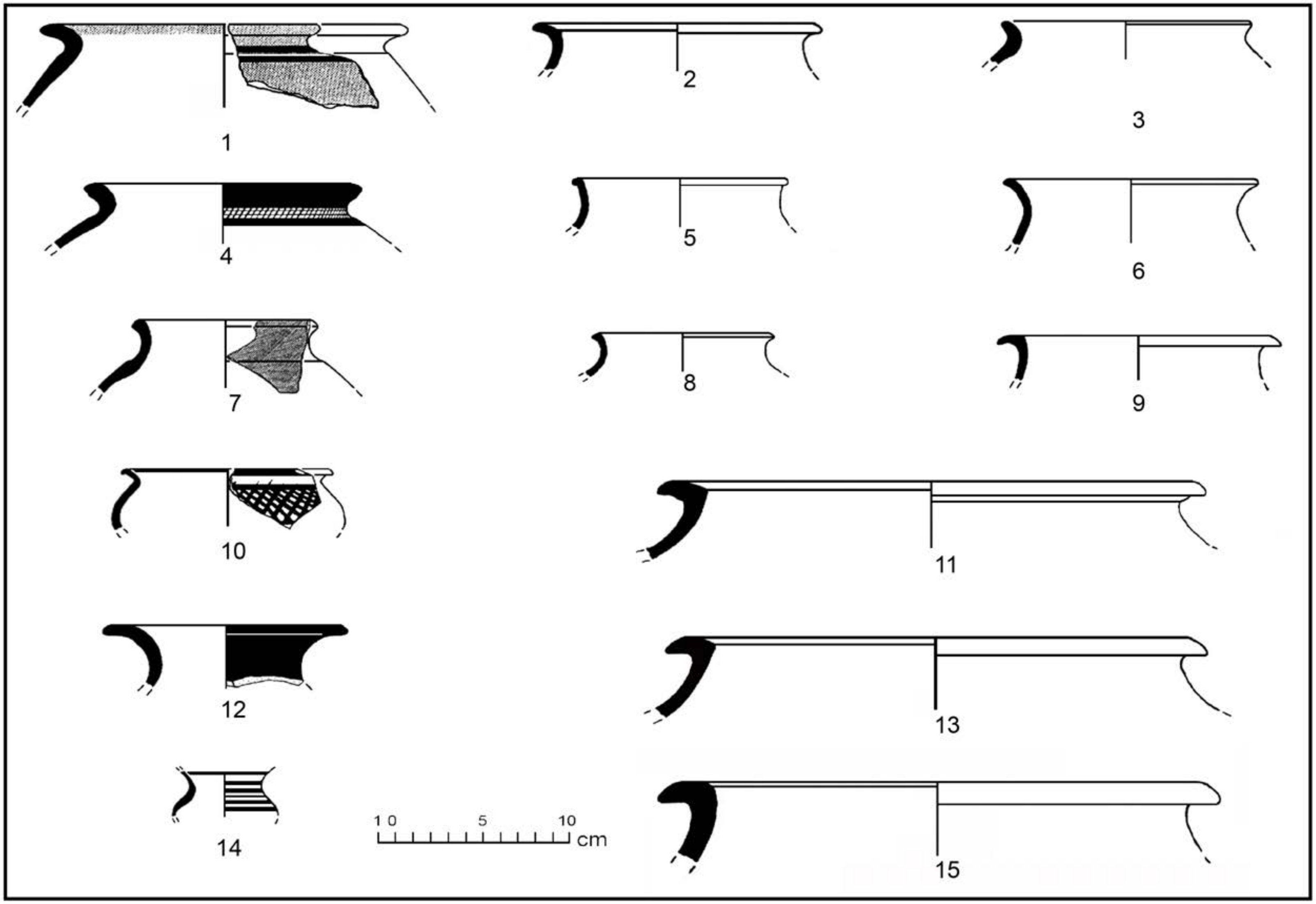
Fig. 7.1: Pottery types from Stage I, Dholavira



Fig. 7.2: Pottery types from Stage I, Dholavira

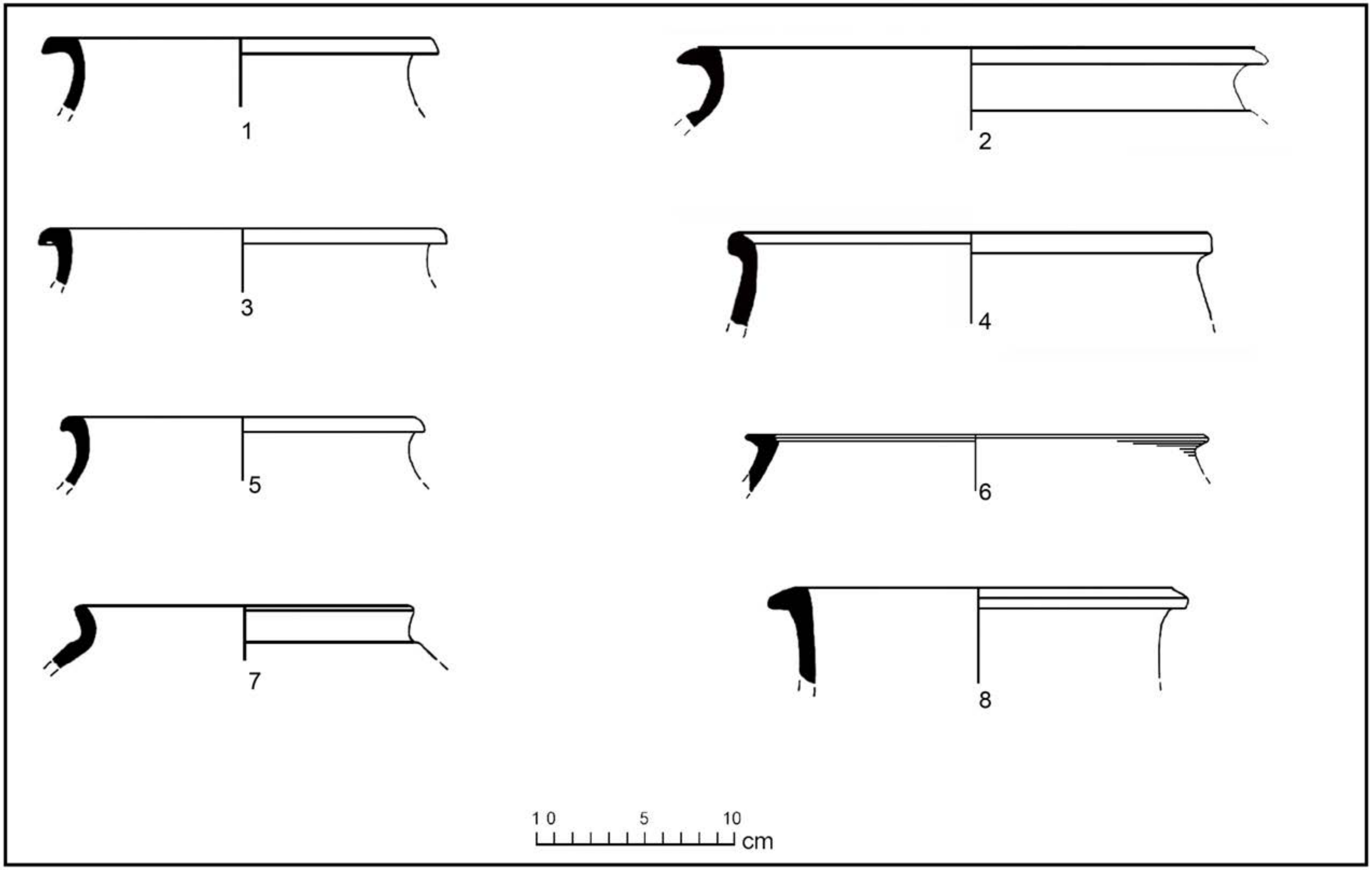


Fig. 7.3: Pottery types from Stage I, Dholavira



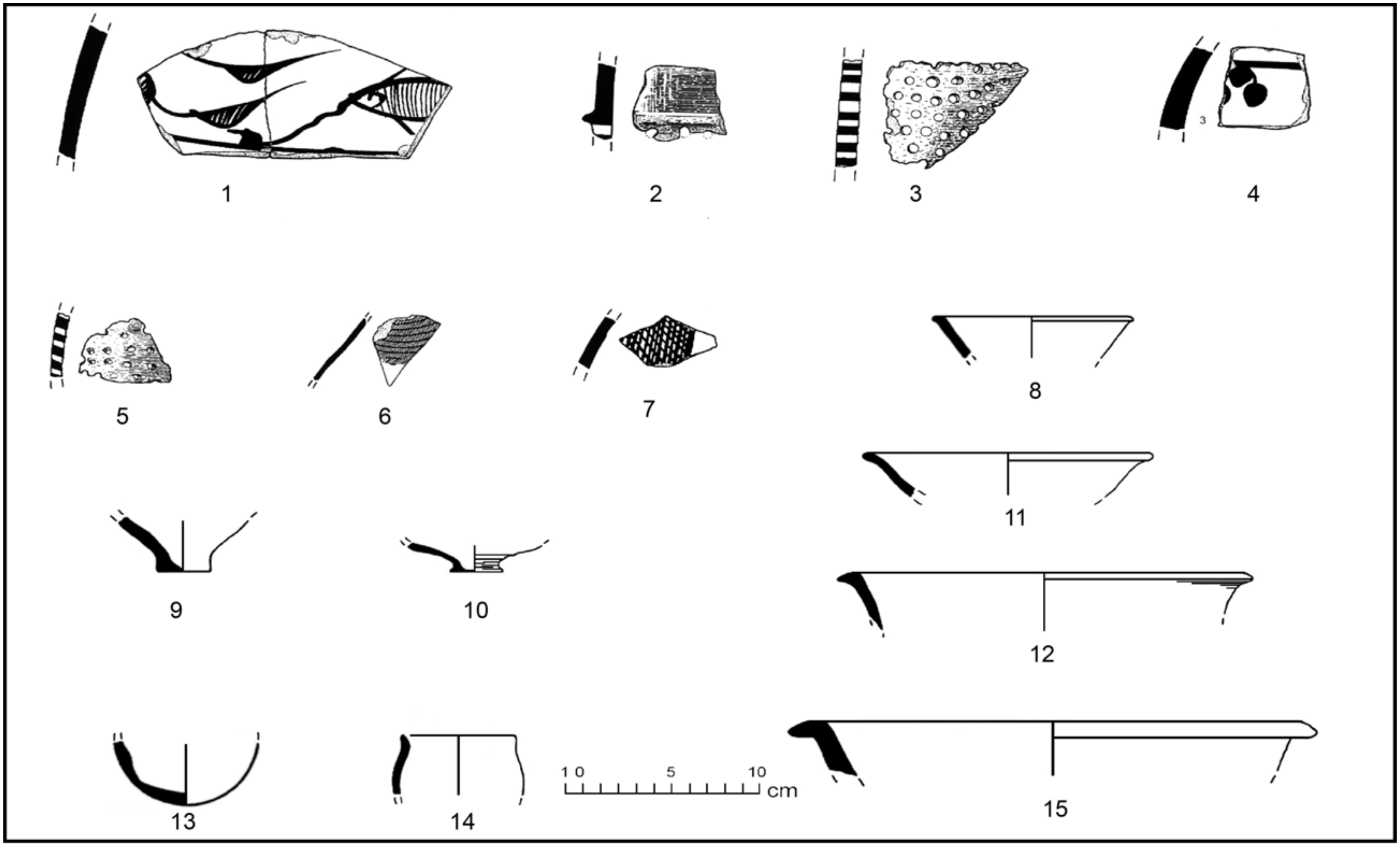
Pottery of Stage II: 1-9, 10-12, 14, 16: Red ware pots (simple, external projecting, everted and beaked rims), 11, 13, 15: Red ware pots (with external projecting, round and beaked rims)

Fig. 7.4: Pottery types from Stage II, Dholavira



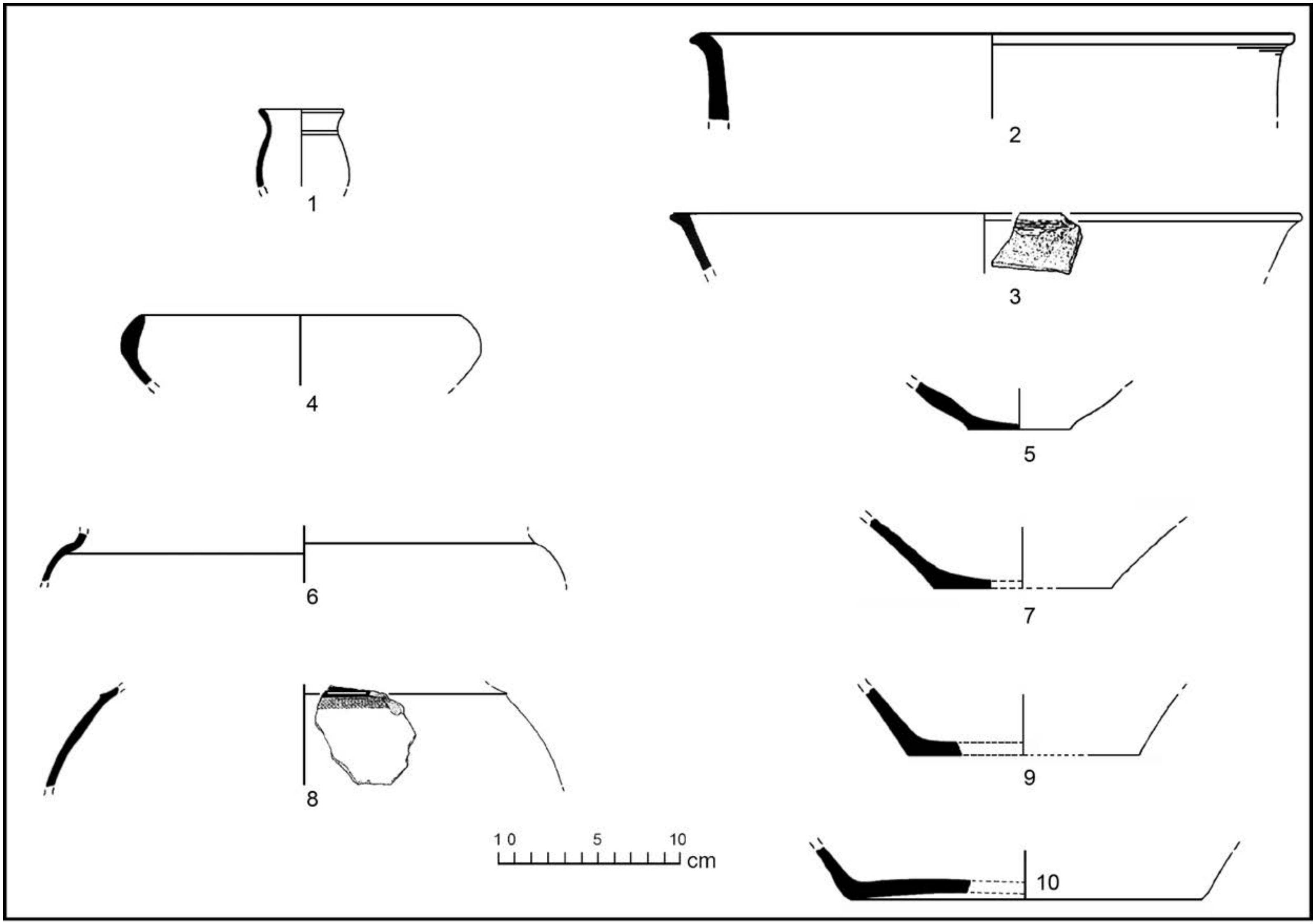
Pottery of Stage II: 1-3, 5,7: Red ware pots (simple, external projecting, everted and beaked rims), 2, 4, 6: Red ware pot / jar (with external projecting, round and beaked rims)

Fig. 7.5: Pottery types from Stage II, Dholavira



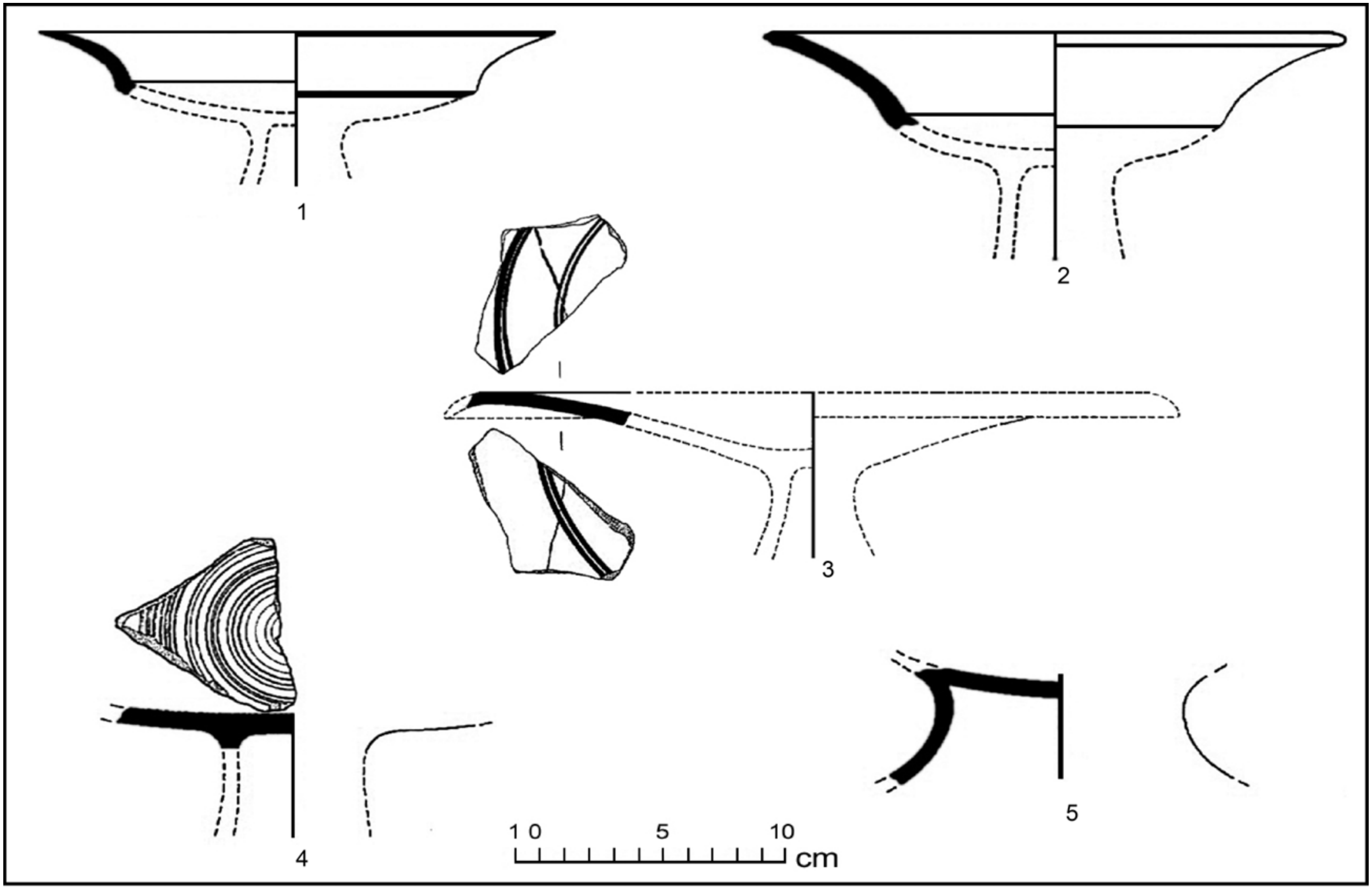
Pottery of Stage II: 1, 4, 6, 7: Red ware Non diagnostic painted sherds (naturalistic and geometric designs like a fish with a fragmentary aquatic motif, solid circles from a horizontal band and parallel lines cutting at angles forming triangles etc); 2, 3, 5: perforated jar fragments; 13: pot bases (contiguous concave and flat); 8, 11: dish (with simple, externally projecting rim); 14: small pot, with slightly everting rim; 9-10: non-contiguous bases of goblets? 13: pot (with simple, everted rims, globular body); 12, 15: bowls with small beaked rims.

Fig. 7.6: Pottery types from Stage II, Dholavira



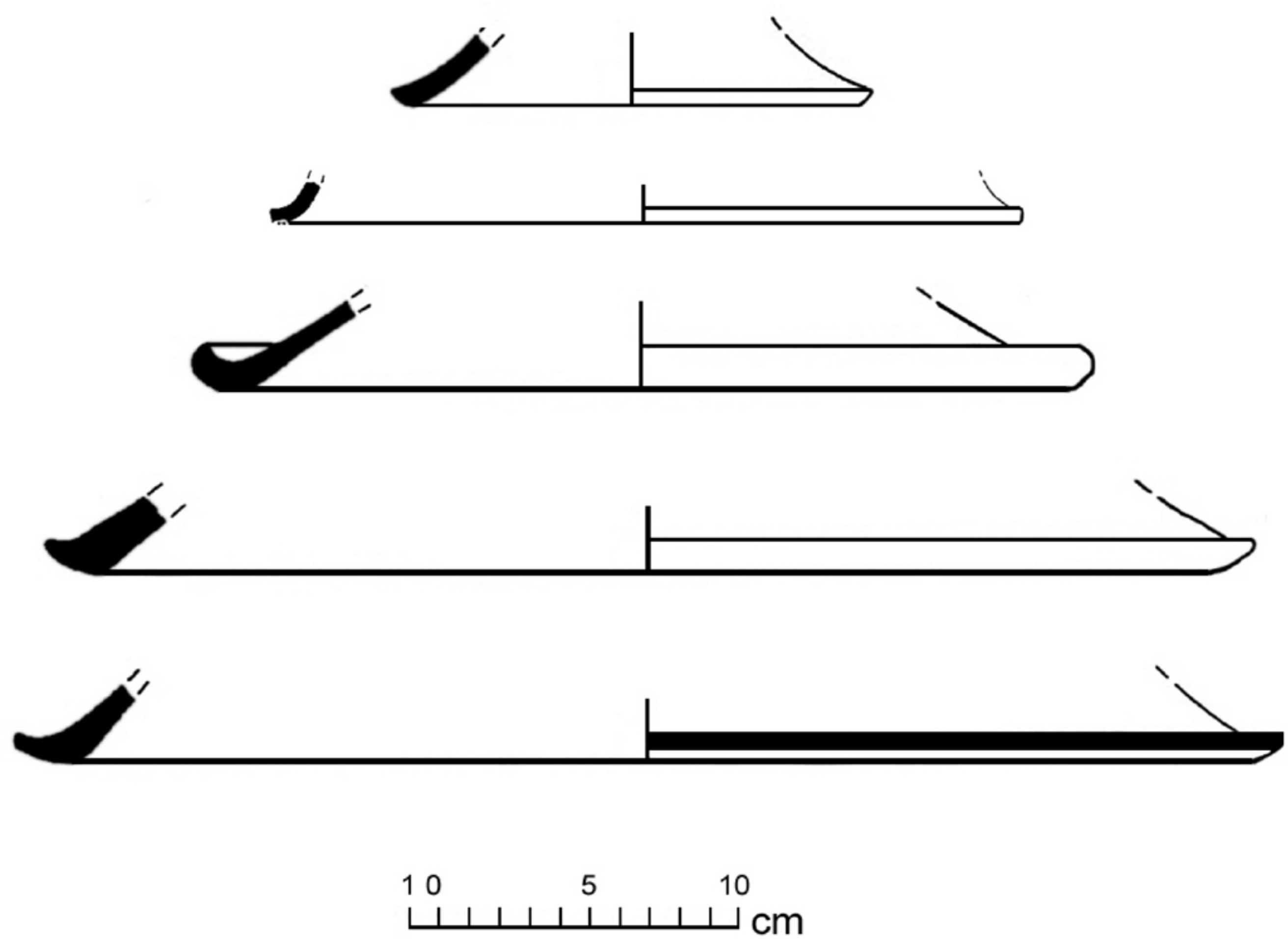
Pottery of Stage II: 1: Small pot with slightly everted rim; 5, 7, 9-10: Jar bases (contiguous concave and flat), 4: Bowl with internal projecting rim and convexsides; 6, 8: Body fragments of pots; 2-3: Bowls with slightly everted rims

Fig. 7.7: Pottery types from Stage II, Dholavira



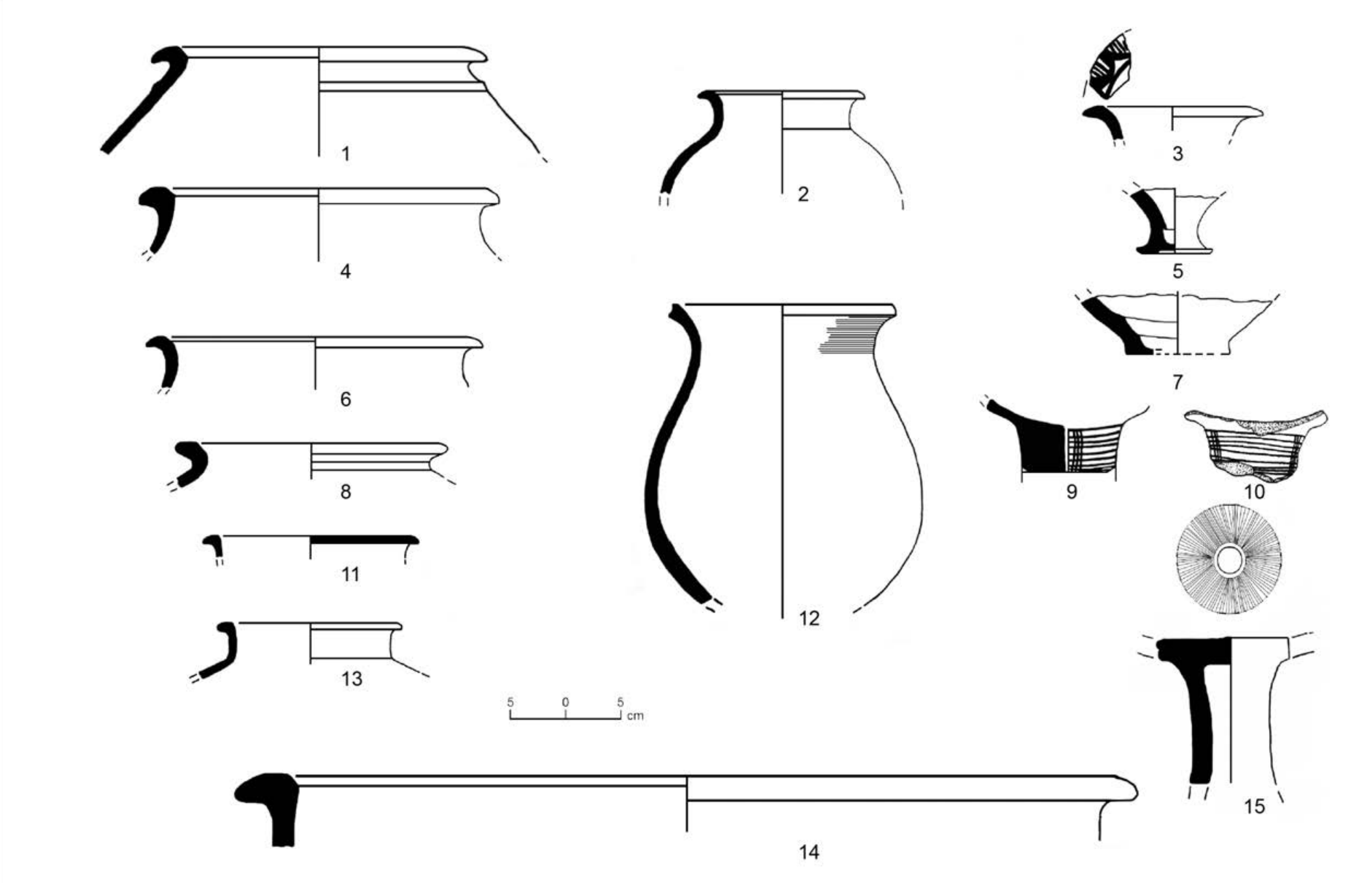
Pottery of Stage II: 1-3: Red ware dish of a dish-on-stand (complex, externally projecting wide beaked rims), 4-5: Central portion of a dish-on-stand (broken)

Fig. 7.8: Pottery types from Stage II, Dholavira



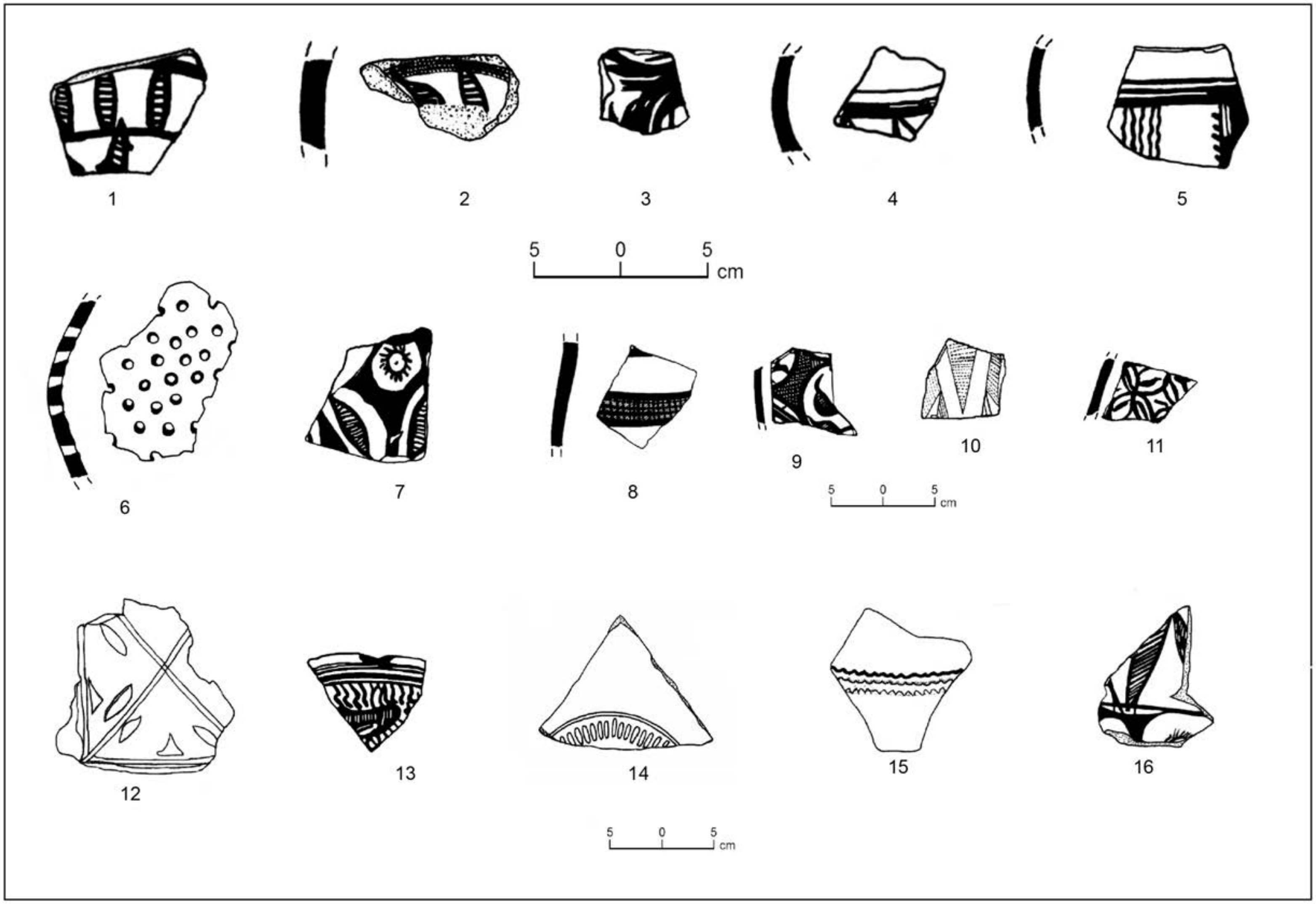
Pottery of Stage II: Bases of dishes-on-stand

Fig. 7.9: Pottery types from Stage II, Dholavira



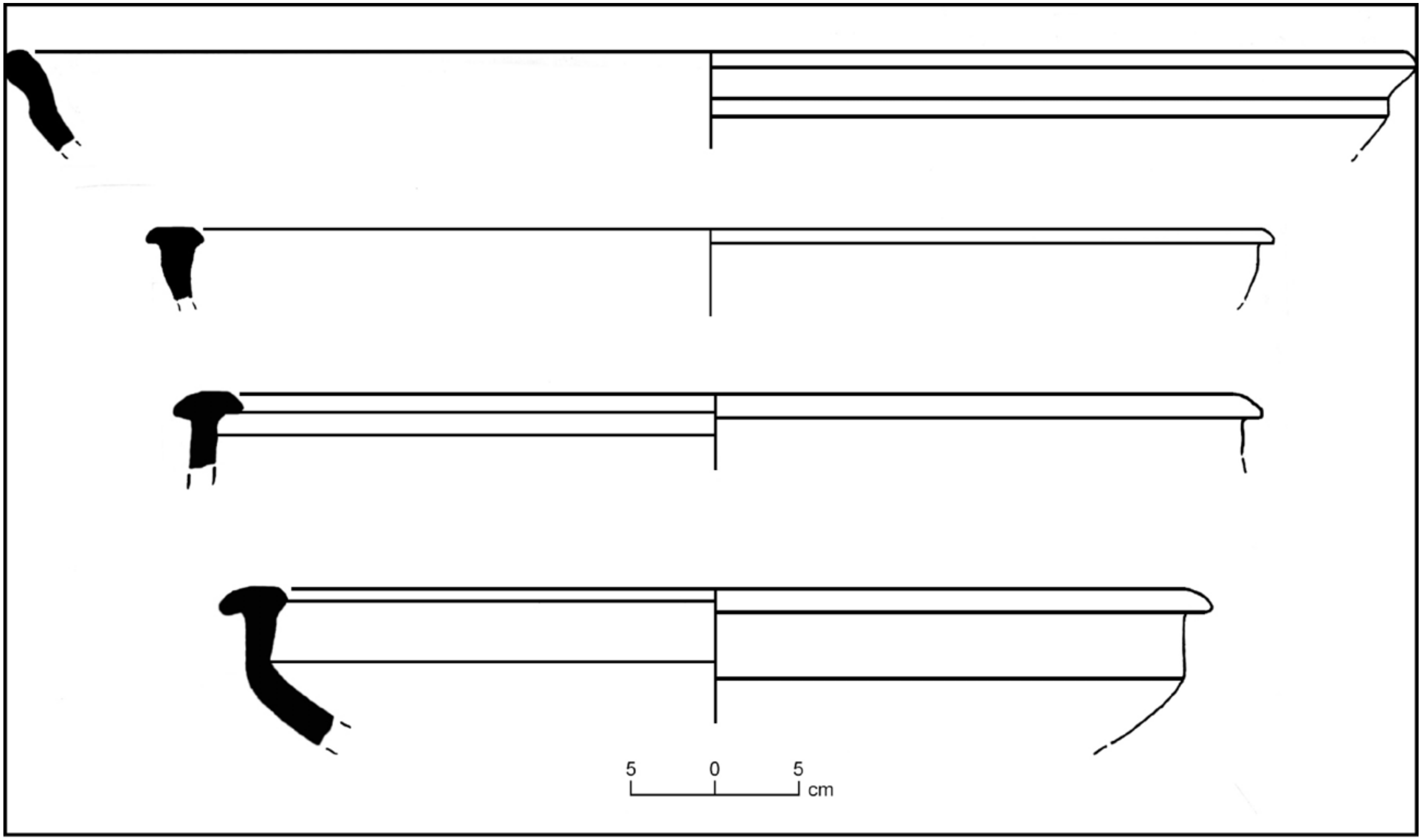
Pottery of Stage III: 1, 3, 4, 6, 11, 13: Pot / Jar of red ware with simple to sharply external projecting and beaked rims; 8: Pot of red ware with everted rim and short neck; 2: Pot of red ware with simple everted rim; 12: Jar with an everted rim; 5: Discoid base of a goblet; 7: Non-contiguous base of a pot; 9, 10 and 15: Central portion of a dish-on-stand (broken), 14: basin (bilateral projecting, more external projecting large rim)

Fig. 7.10: Pottery types from Stage III, Dholavira



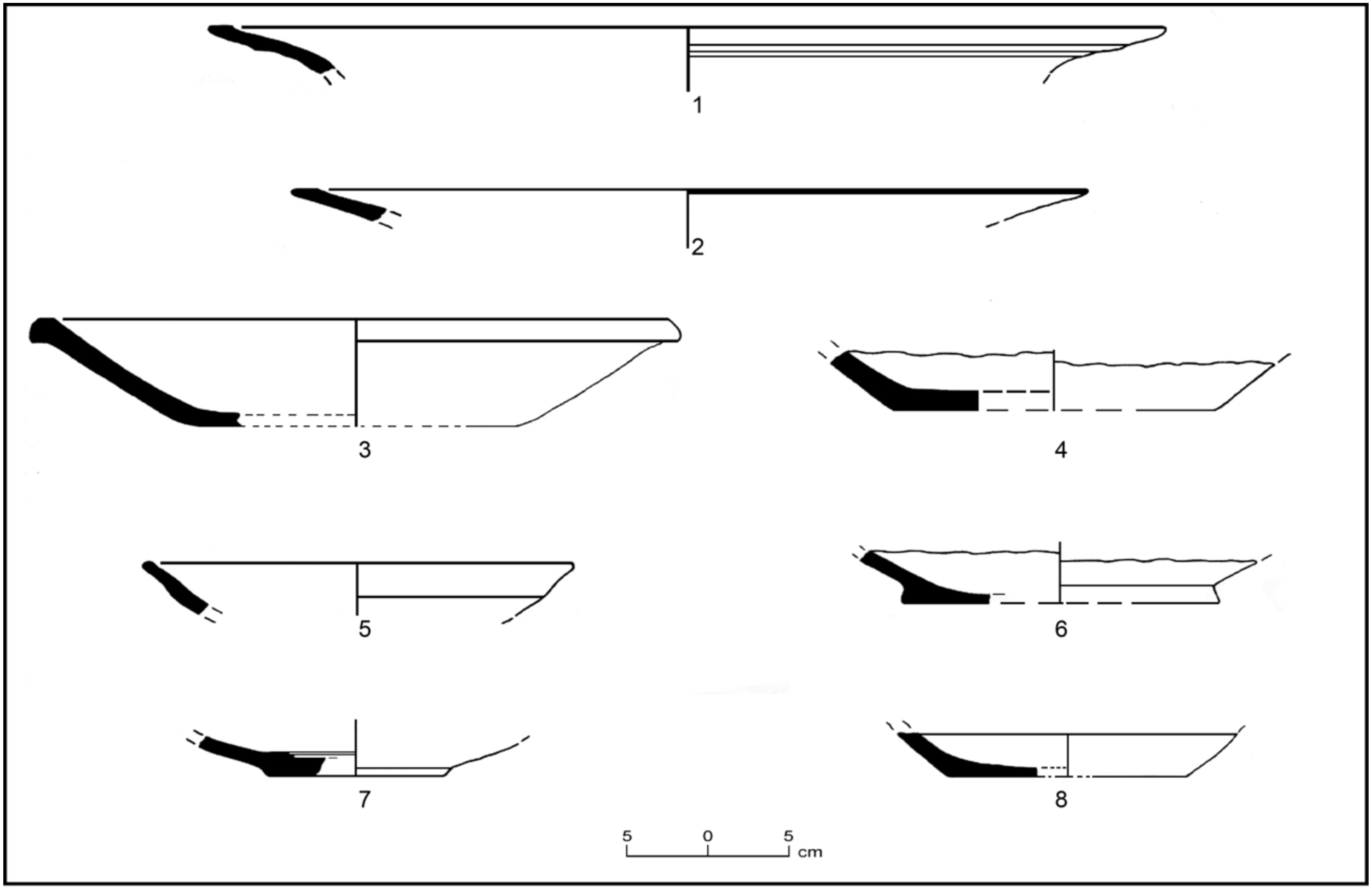
Pottery of Stage III: 1-4,7-11,13, 16: Non diagnostic painted sherds (geometric and naturalistic deigns like parallel and criss cross lines, hatched leafs, rayed circle and a dot enclosed in a layered circle etc), 6: perforated jar fragment, 12,15: Body fragments of red ware with incised decorations
14: dish of a dish-on-stand (broken centre portion with incised decorations)

Fig. 7.11: Pottery types from Stage III, Dholavira



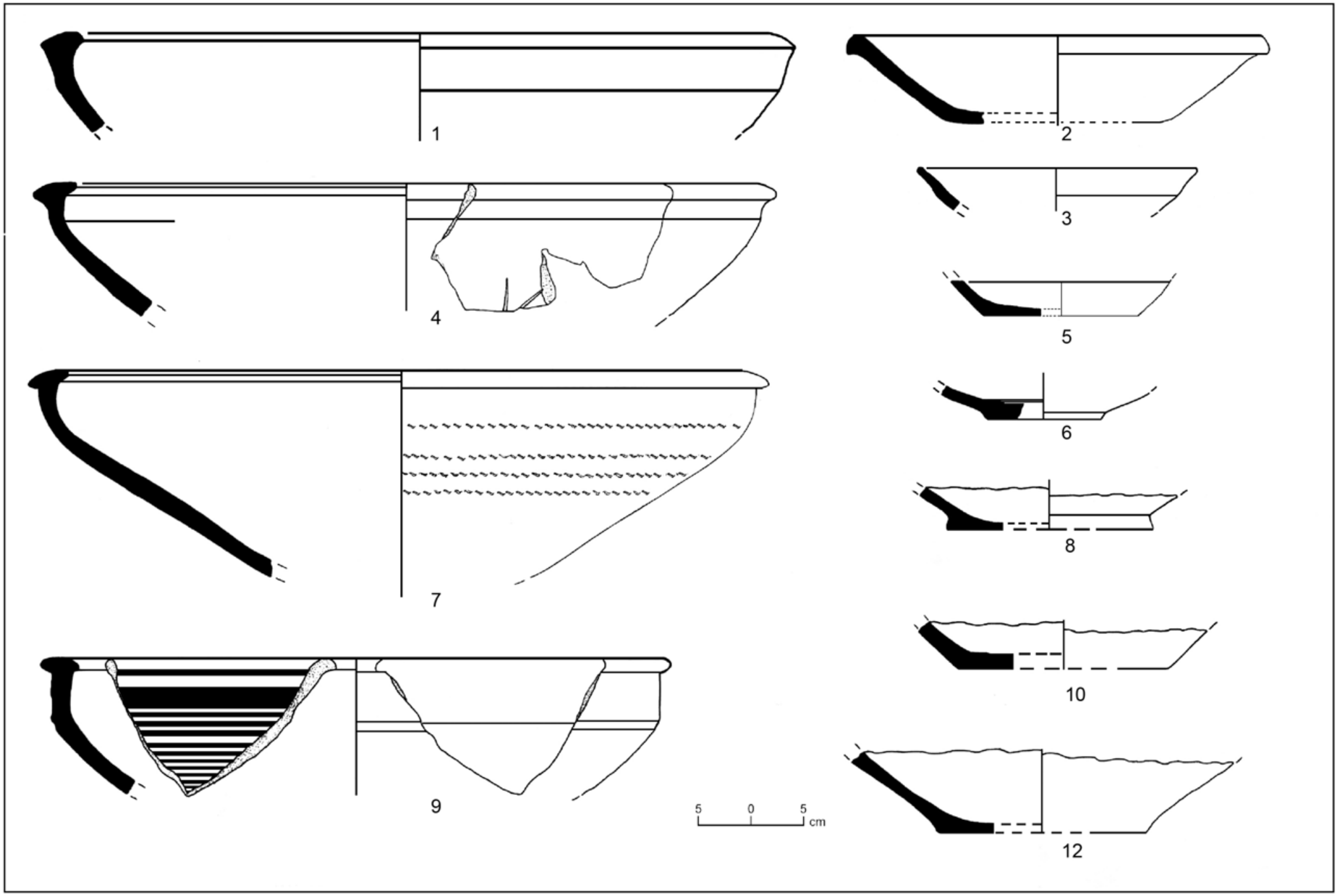
Pottery of Stage III: Red ware Basins (complex, bilateral projecting, more external and internal projecting rims)

Fig. 7.12: Pottery types from Stage III, Dholavira



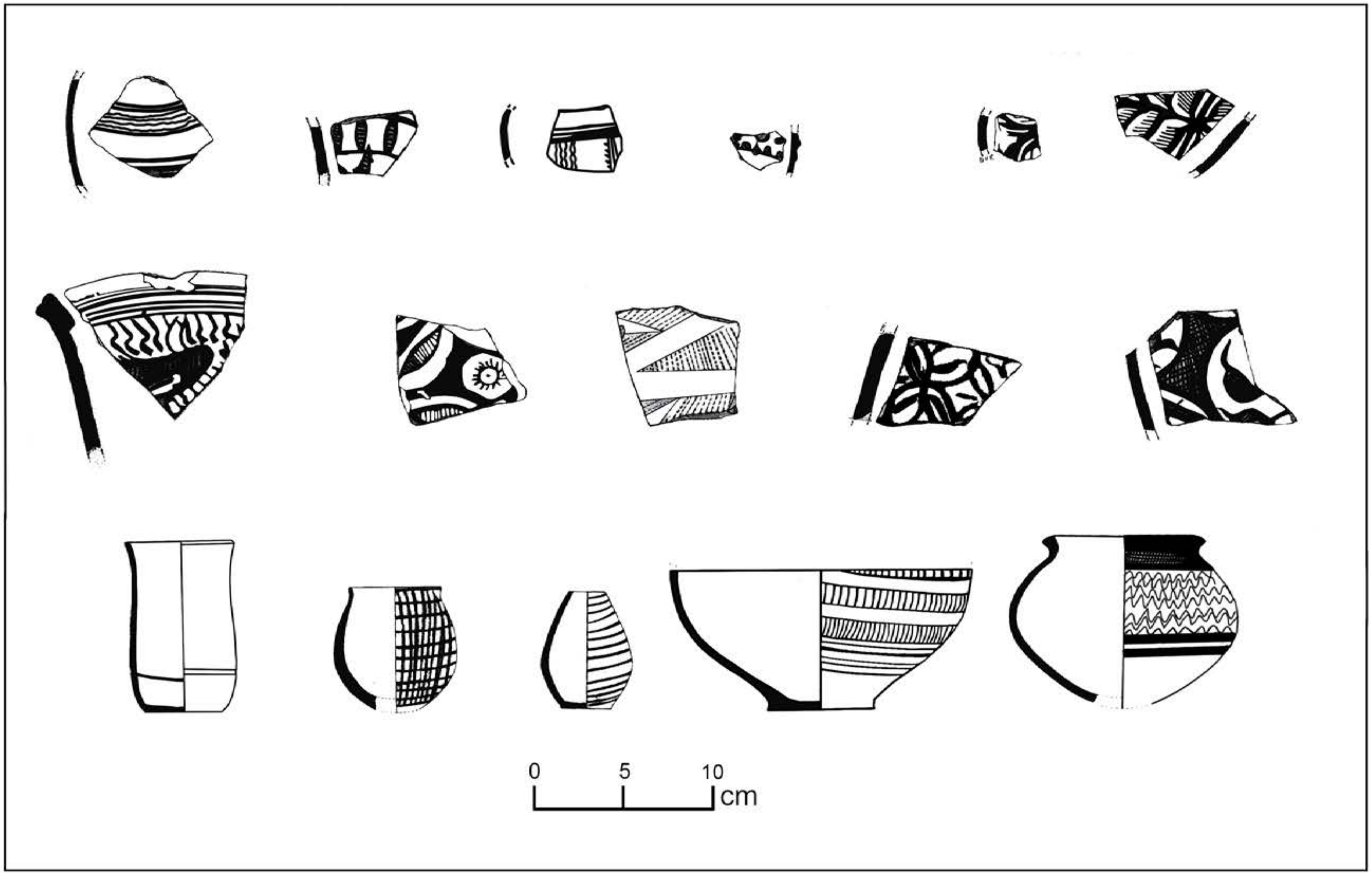
Pottery of Stage III: 1-2: Wide mouthed and external projecting rims of dishes; 3: Dish of red ware (external projecting rounded rim); 4: Base of a dish; 5: Bowl wtih featureless rim; 6-8: pot bases (contiguous flat and non-contiguous discoid)

Fig. 7.13: Pottery types from Stage III, Dholavira



Pottery of Stage III: 1, 4, 7: Red ware Basins (complex, bilateral projecting, more external and internal projecting rims, with and without carinated body); 2: Dish (external projecting rounded rim), 9: dish (external projecting rim), 3, 5, 6, 8, 10, 12: pot bases (contiguous flat and non contiguous discoid)

Fig. 7.14: Pottery types from Stage III, Dholavira



Painted pottery from Stage III

Fig. 7.15: Painted Pottery types from Stage III, Dholavira



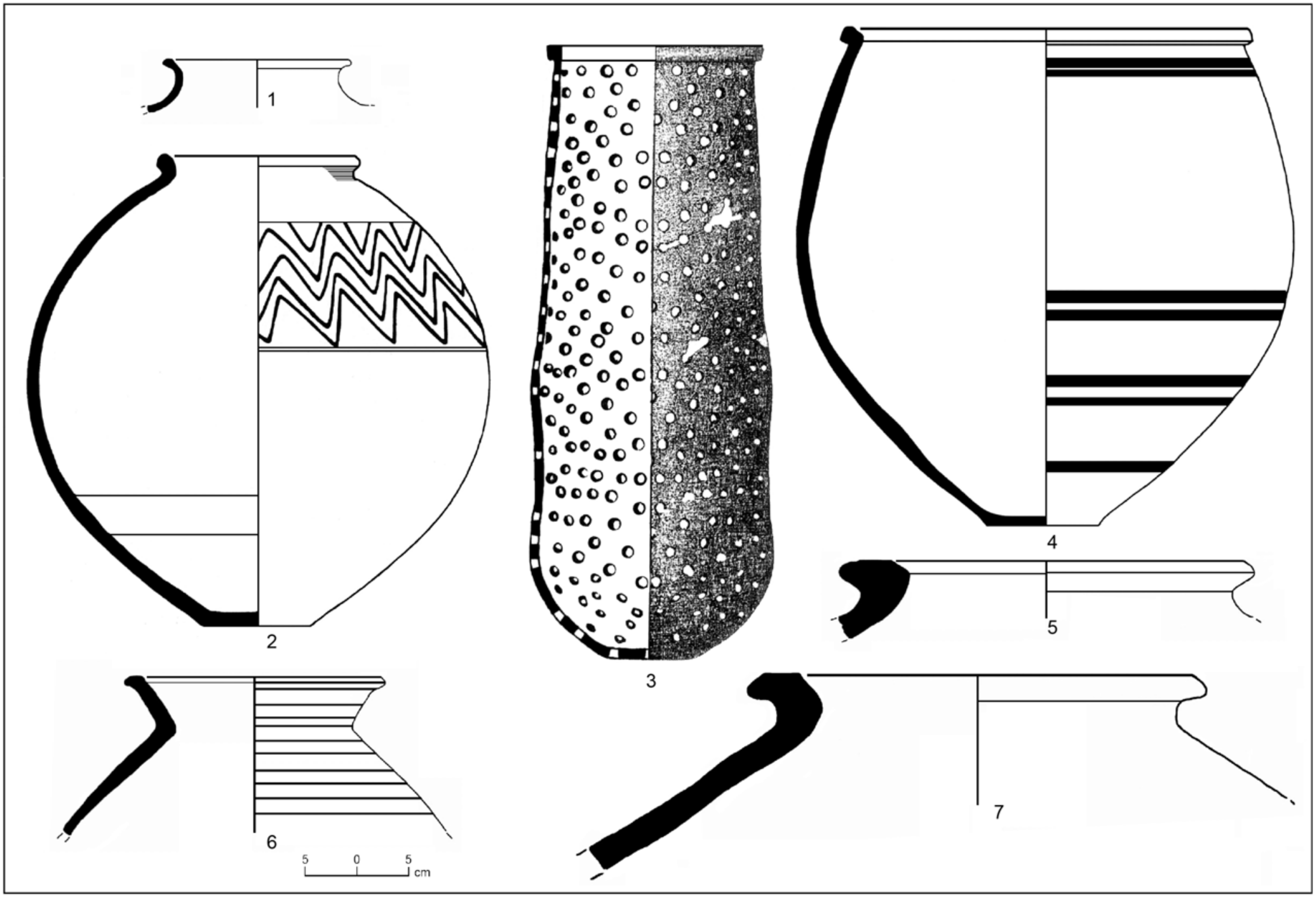
Fig. 7.16: Pottery types from Stage III, Dholavira



Fig. 7.17: Pottery types from Stage III, Dholavira

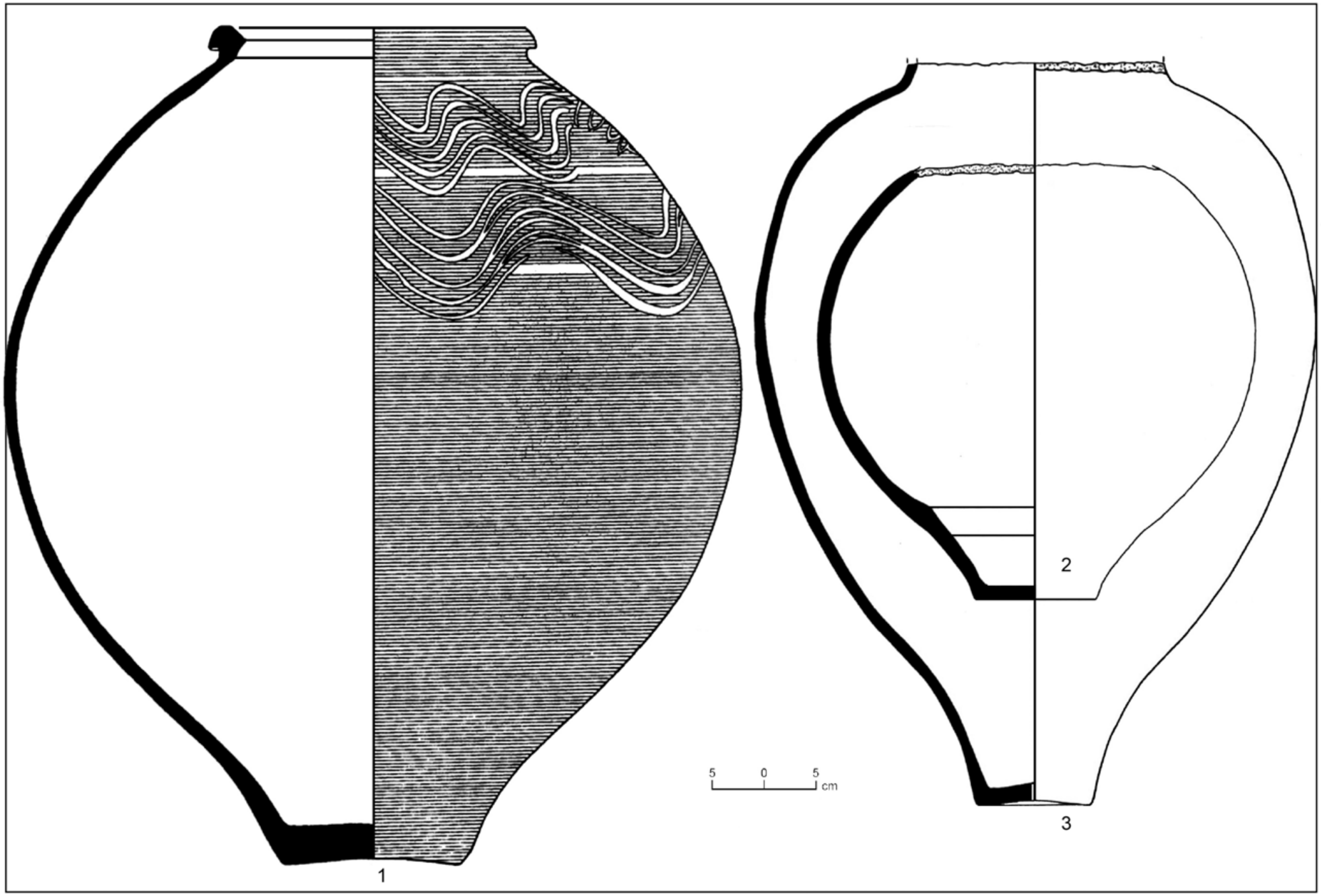


Fig. 7.18: Pottery types from Stage III, Dholavira



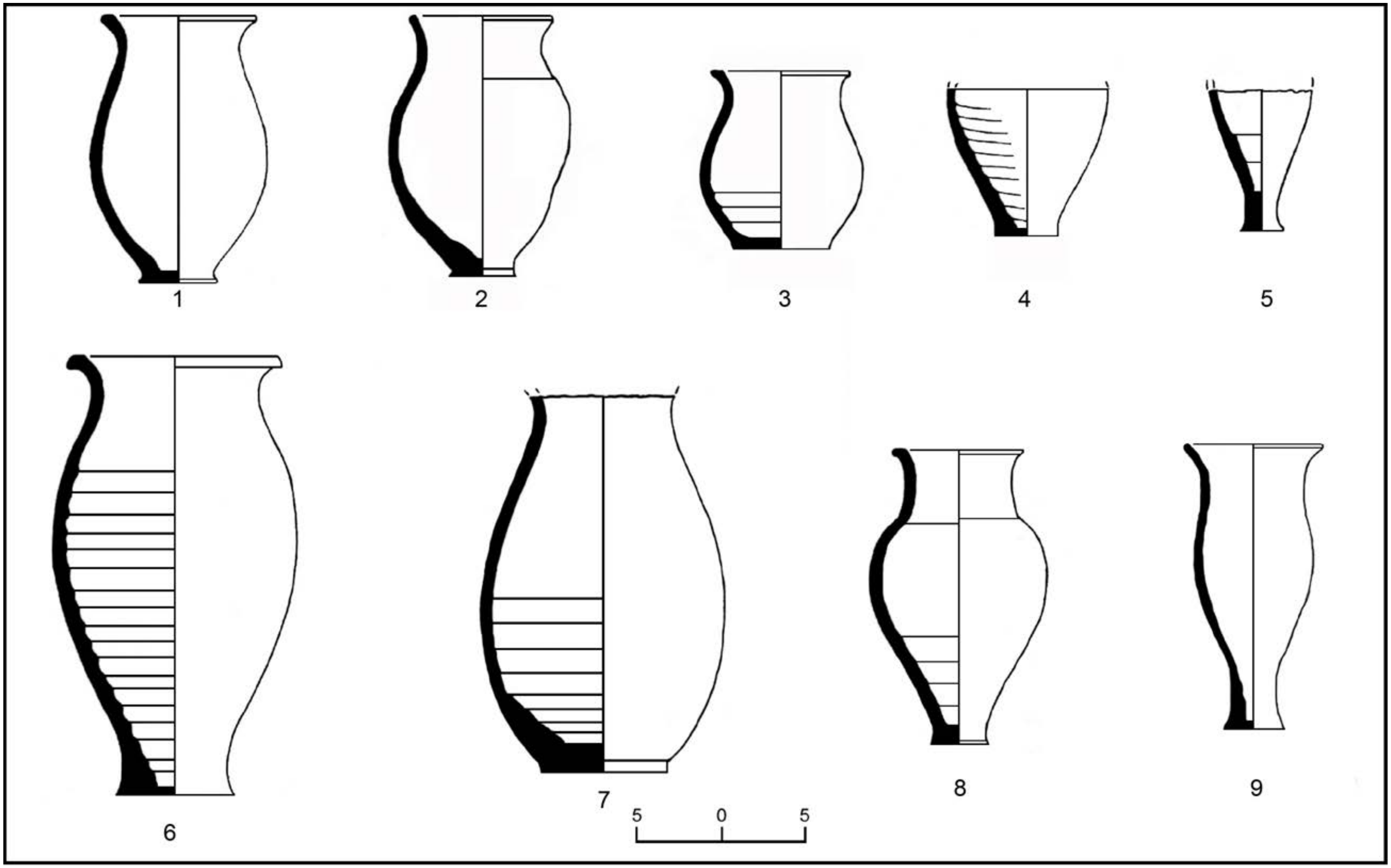
Pottery of Stage IV: 1-3, 5-7: Red ware jars (external projecting, everted, beaked and rounded thick rims, bulbous or globular body and contiguous flat base; 2 decorated with wavy lines in black coloure and 4 decorated with horizontal bands), 4: perforated jar (external projecting, wide quadrangular rims)

Fig. 7.19: Pottery types from Stage IV, Dholavira



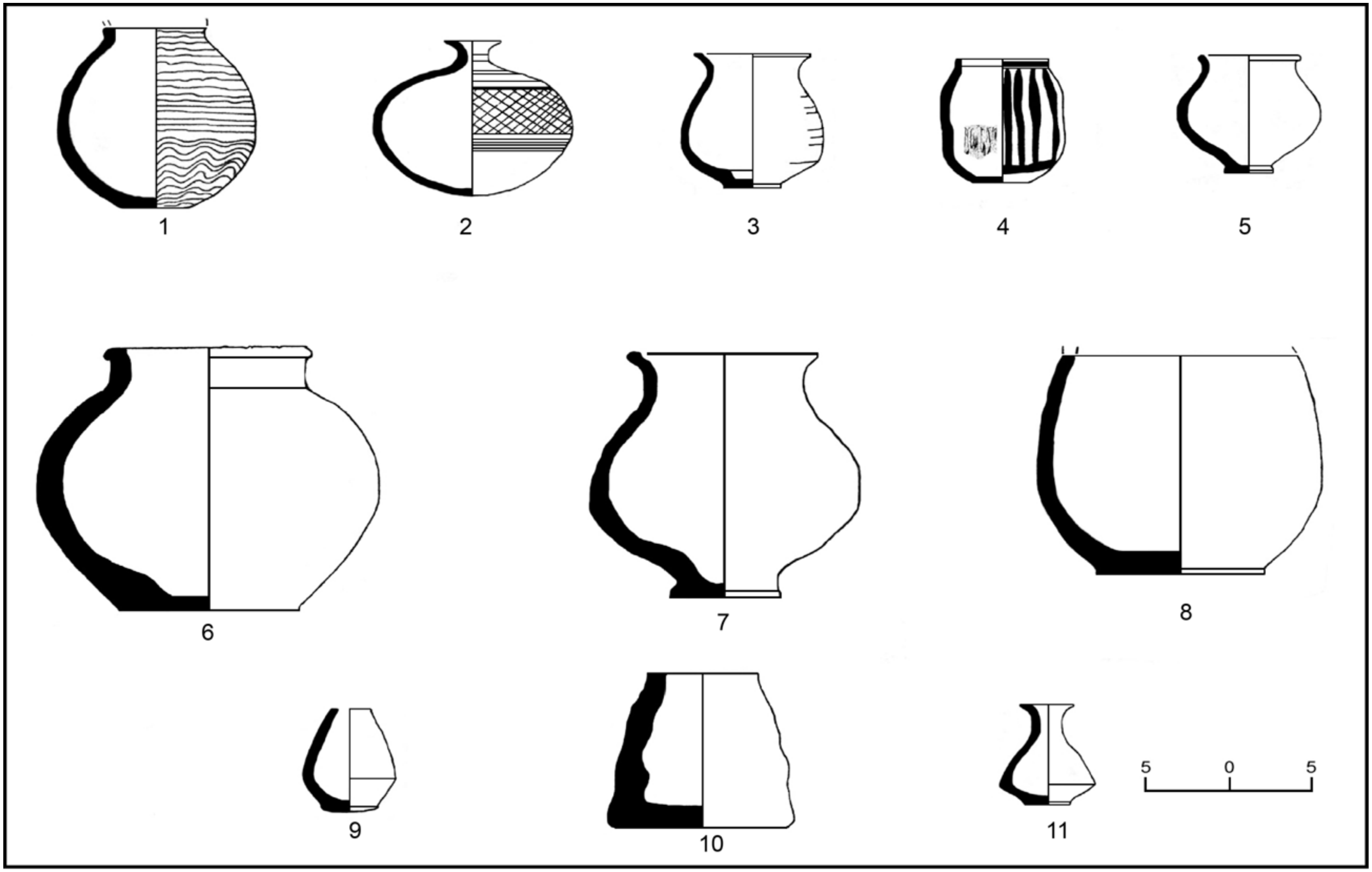
Pottery of Stage IV: 1: Storage Jar (external projected beaked rim bulbous body and contiguous concave base, decorated with wavy lines on the shoulder and upper body), 2-3: Storage Jars (bulbous, slightly globular body with a pointed base, contiguous flat and concave base and broken rim)

Fig. 7.20: Pottery types from Stage IV, Dholavira



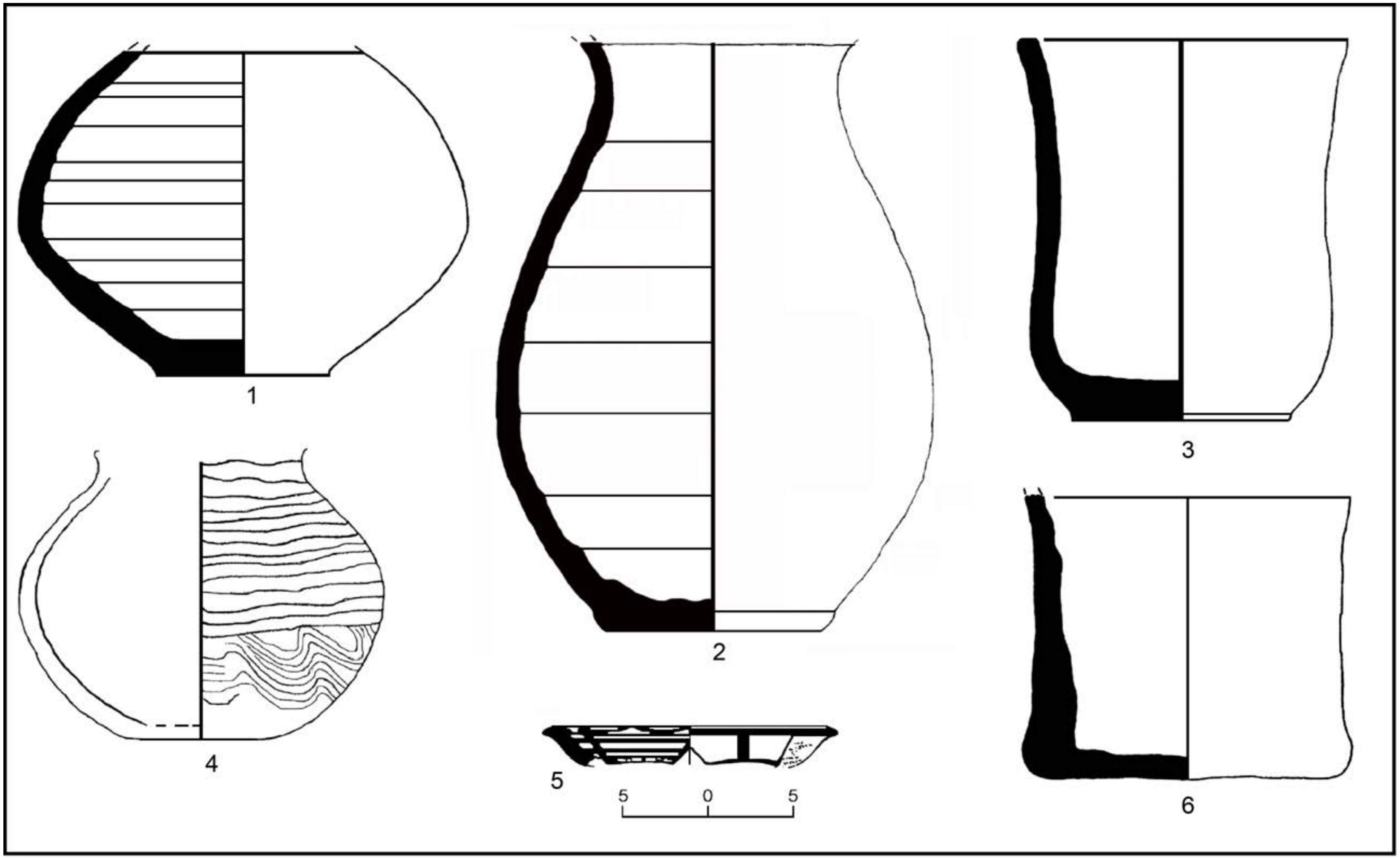
Pottery of Stage IV: 1-3: Jars of red ware vase (everted external projecting rim, elliptical body, and non contiguous discoid and narrow solid bases); 4, 6-7: Tall jars with elliptical body forms, evidence of coiling technique of manufacture on interior; 5, 8-9: types of goblets with continguous and non-contiguous bases

Fig. 7.21: Pottery types from Stage IV, Dholavira



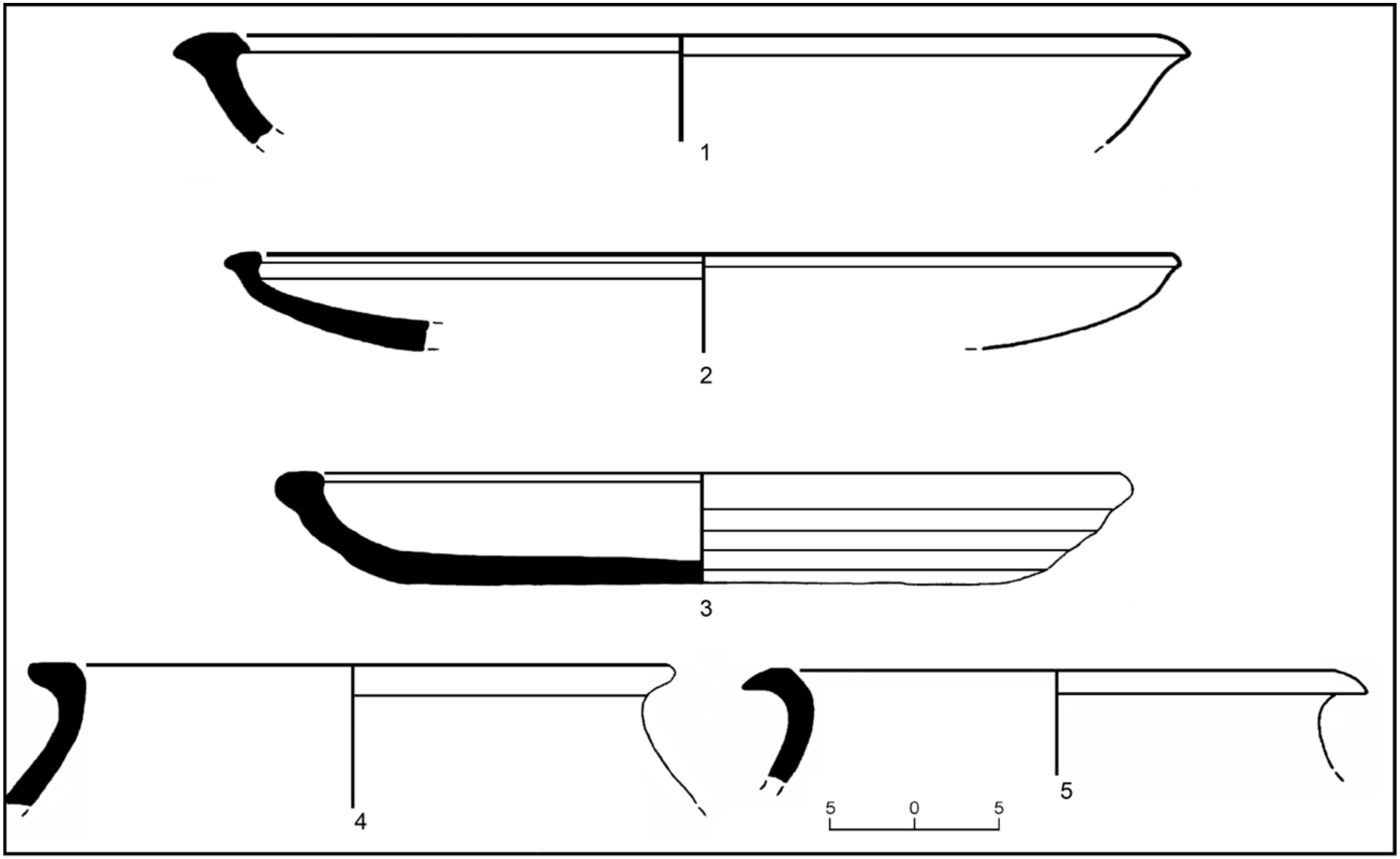
Pottery of Stage IV: 1, 2, 5-8: pots (with simple, external projecting and everted rims, globular or bulbous body and contiguous flat, rounded and discoid bases), 4: jar with vertical and horizontal banded decorations; 9, 11: miniature pots; 10: small jar (contiguous flat base with tapering wall)

Fig. 7.22: Pottery types from Stage IV, Dholavira



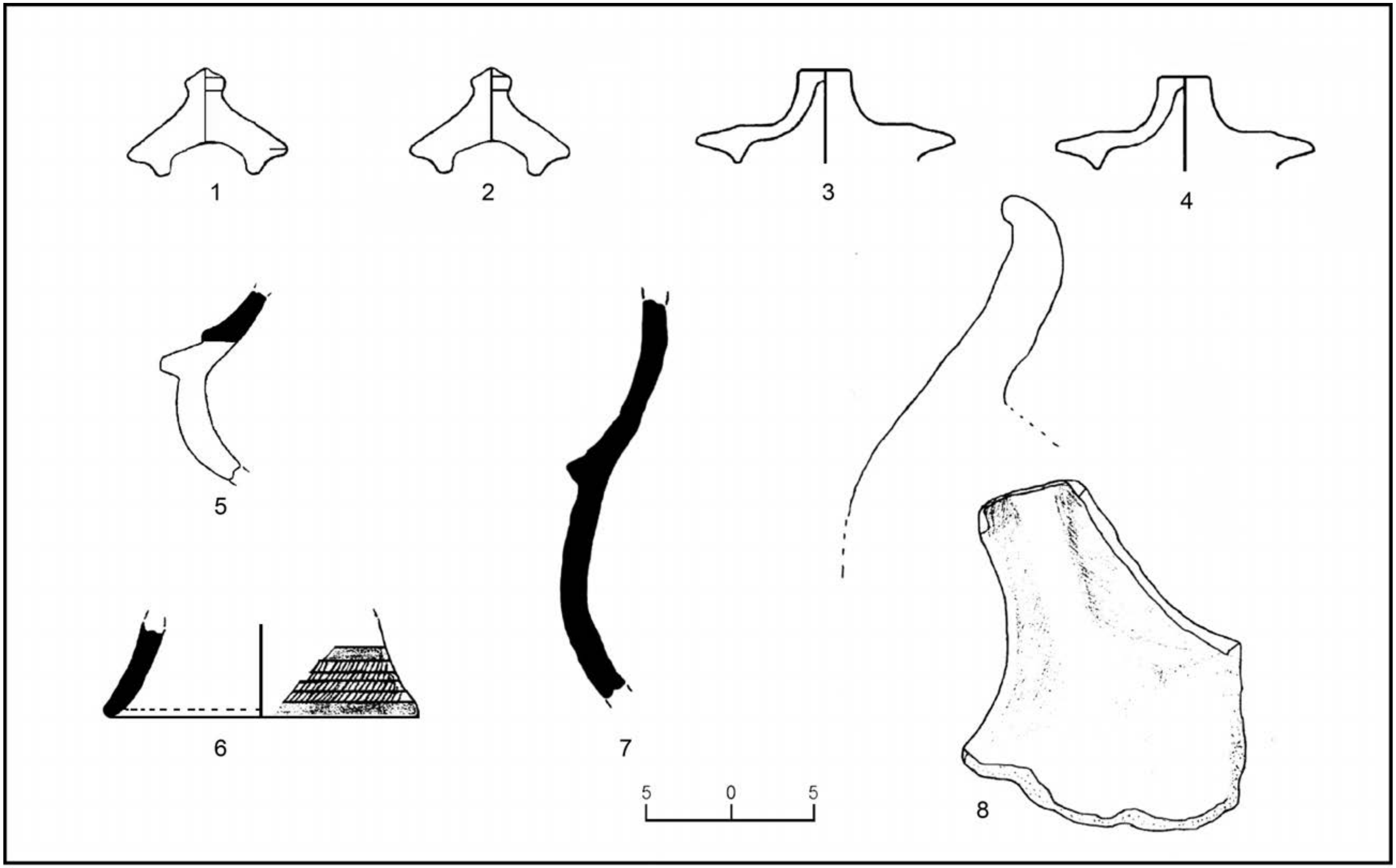
Pottery of Stage IV: 1, 4: Red ware pots (everted external projecting, round, beaked rim, globular or bulbous body, contiguous and non contiguous flat bases), 2: Jar with a short nect and everting rim; 3,6: beaker (external projecting everted rim, contiguous flat and discoid base),

Fig. 7.23: Pottery types from Stage IV, Dholavira



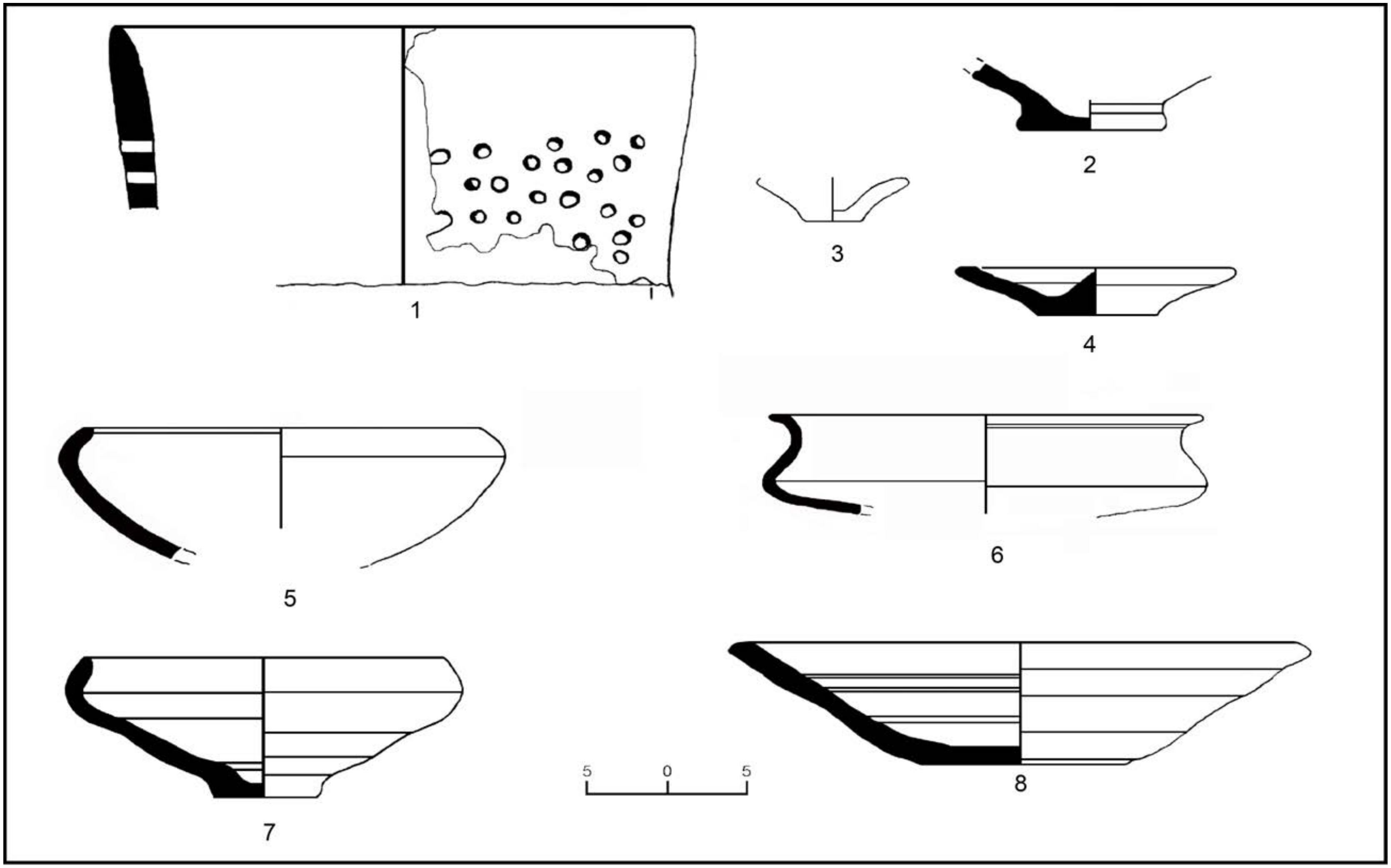
Pottery of Stage IV: 1-3: dish (bilateral projecting, more external and internal projecting rims, with and without corrugated body and contiguous flat base); 4-5: Pots with slightly everting and beaked rims

Fig. 7.24: Pottery types from Stage IV, Dholavira



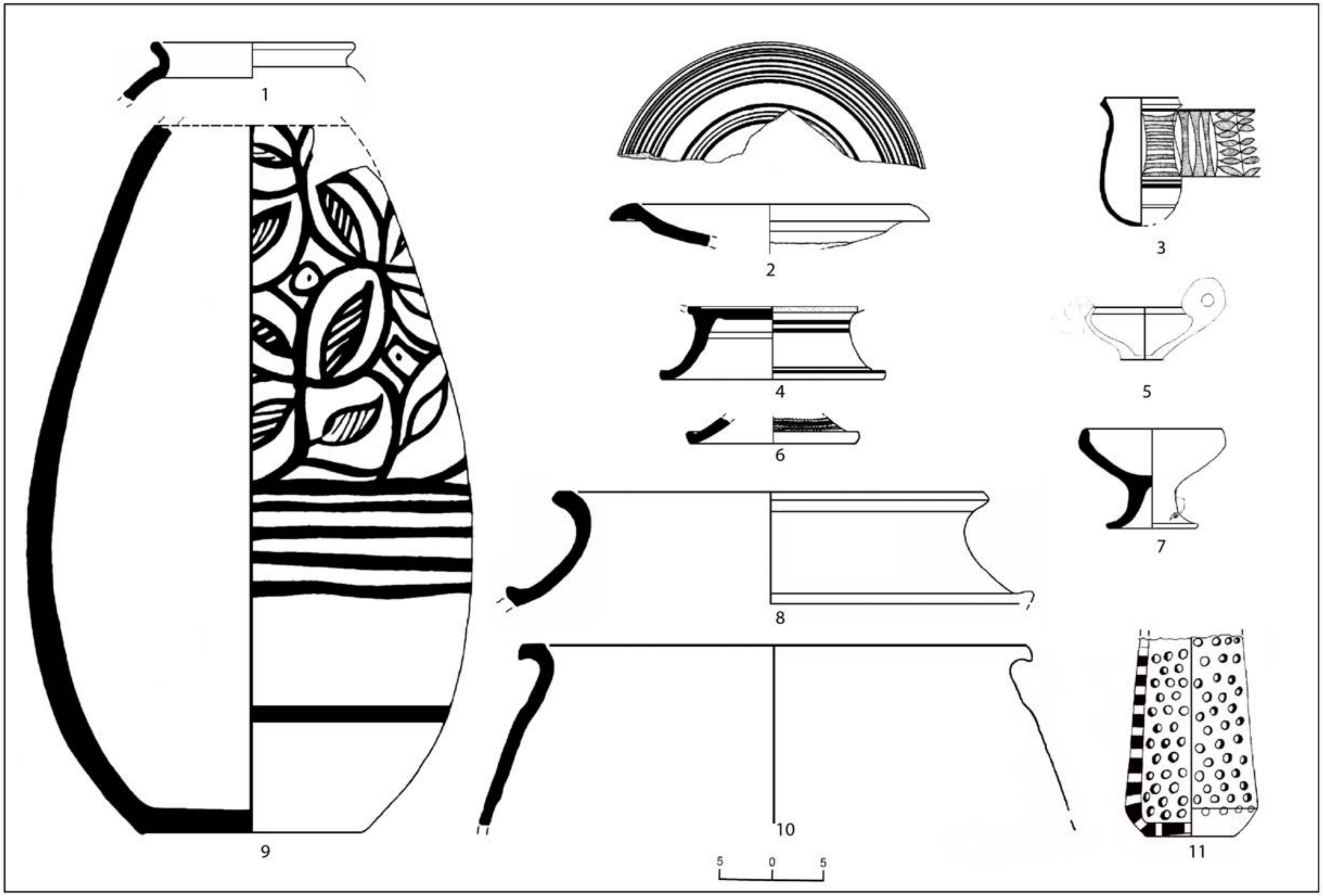
Pottery of Stage IV: 1-4: Red ware lids (inverted rim tapering sides, non contiguous narrow solid base), 5, 7: body fragments of cooking pots; 6: base of a pot-on-stand:; 8: handle of channel spouted bowl

Fig. 7.25: Pottery types from Stage IV, Dholavira



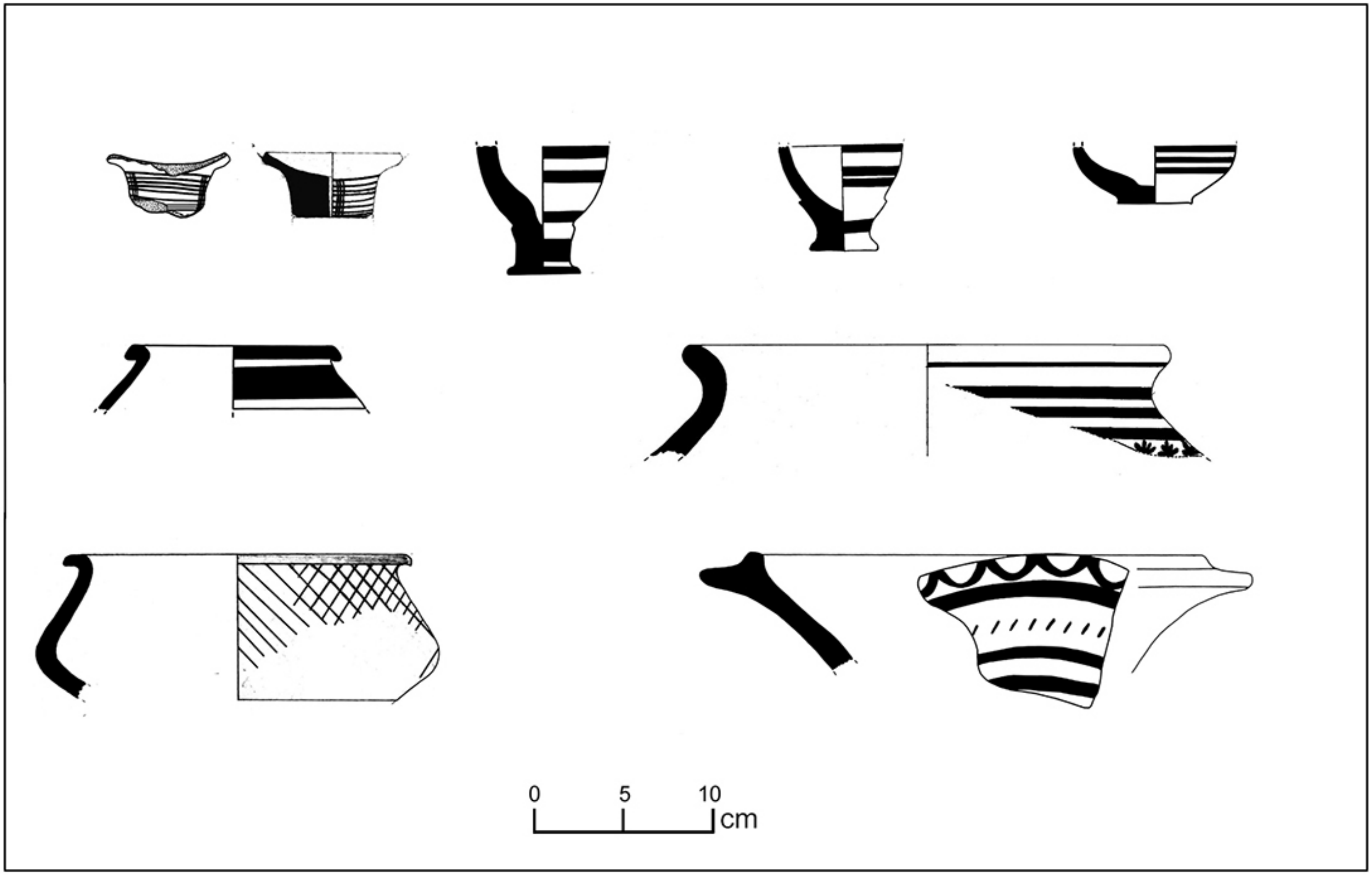
Pottery of Stage IV: 1: Perforated jar fragment with featureless rim; 2: Non-contiguous discoid base of a pot; 3-5: lids; 5, 7: Bowls with incurving rims, one with non-contiguous base; 6: a wide mouthed pot / handi; 8: dish with everting and featureless rim.

Fig. 7.26: Pottery types from Stage IV, Dholavira



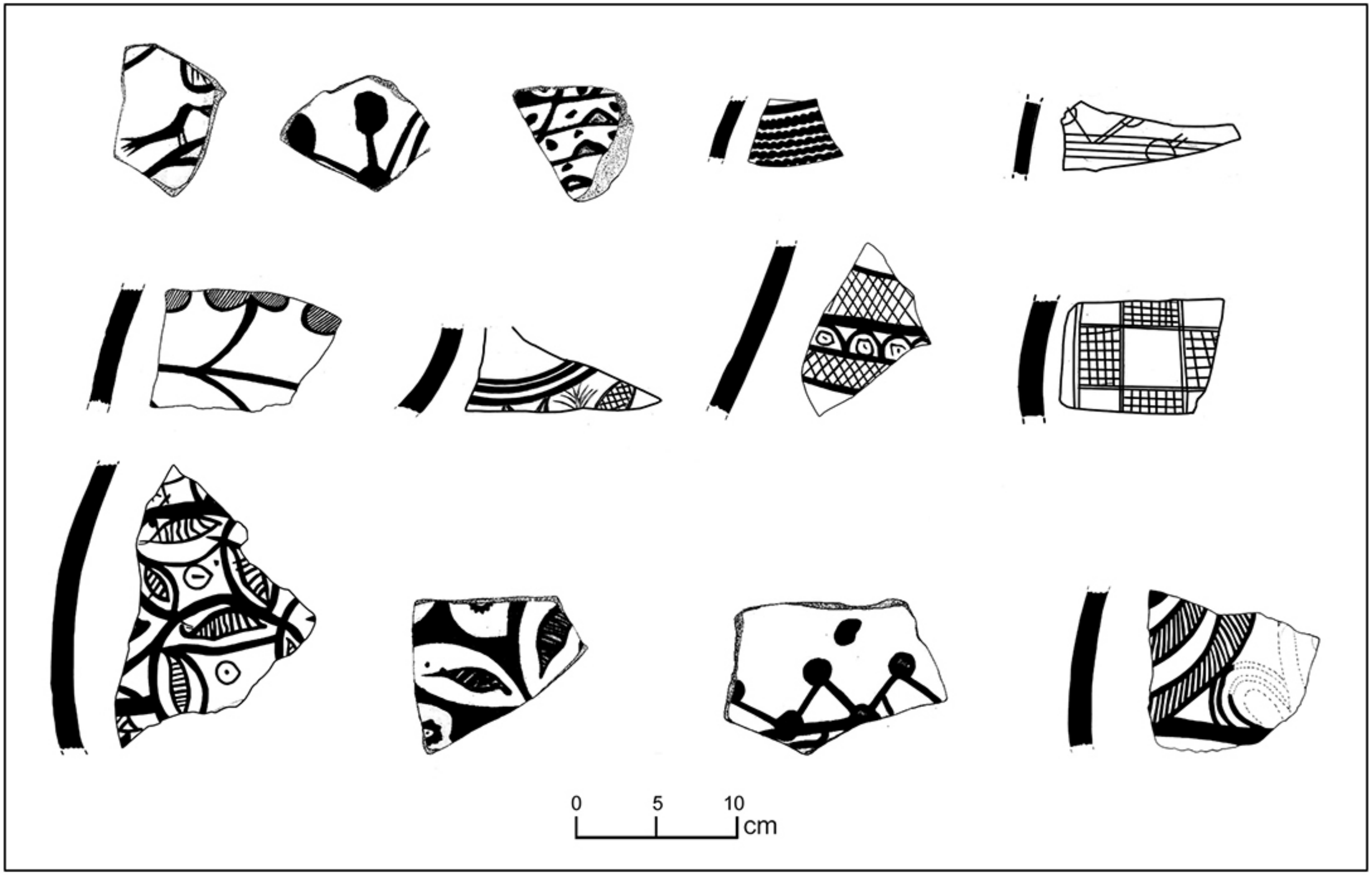
Pottery of Stage IV: 1; Pot of red ware with a simple everting rim; 2: dish of a dish-on-stand with concentric black banded decoration on the top; 3, 9: 'S' shaped jar with black decorations consisting of intersecting circle patterns (9) and alternating horizontal and vertical lozenges and leaf patterns filled with vertical strokes; 4: base of a bowl-on-stand: 6: base of a dish-on-stand; 5: a bird feeding cup; 7: cup-on-stand: 8: ring stand (external projecting rim and low pedestal base), 10: wide mouthed storage jar; 11: base portion of a perforated jar

Fig. 7.27: Pottery types from Stage IV, Dholavira



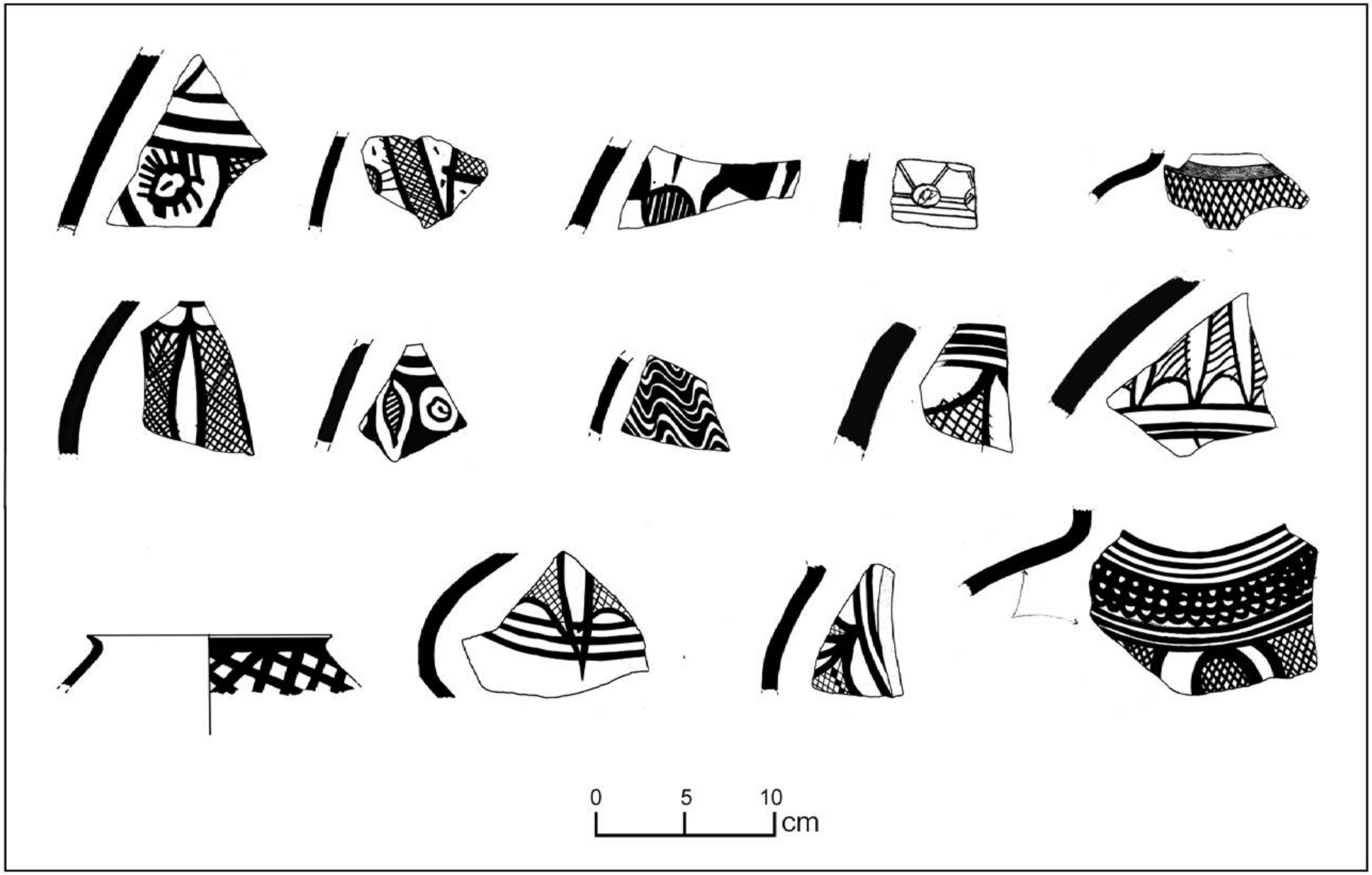
Painted pottery from Stage IV

Fig. 7.28: Painted Pottery types from Stage IV, Dholavira



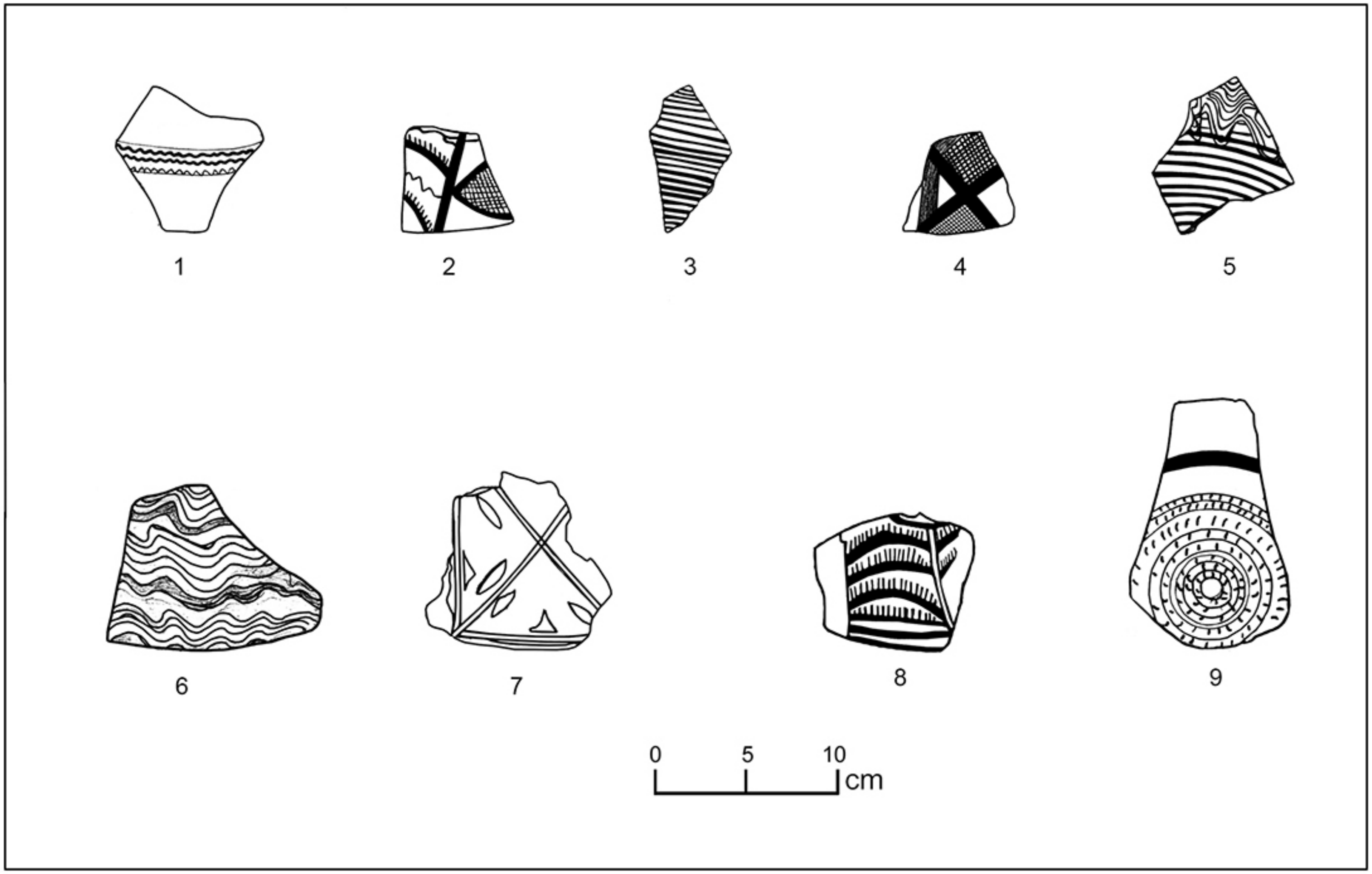
Painted pottery from Stage IV

Fig. 7.29: Painted Pottery types from Stage IV, Dholavira



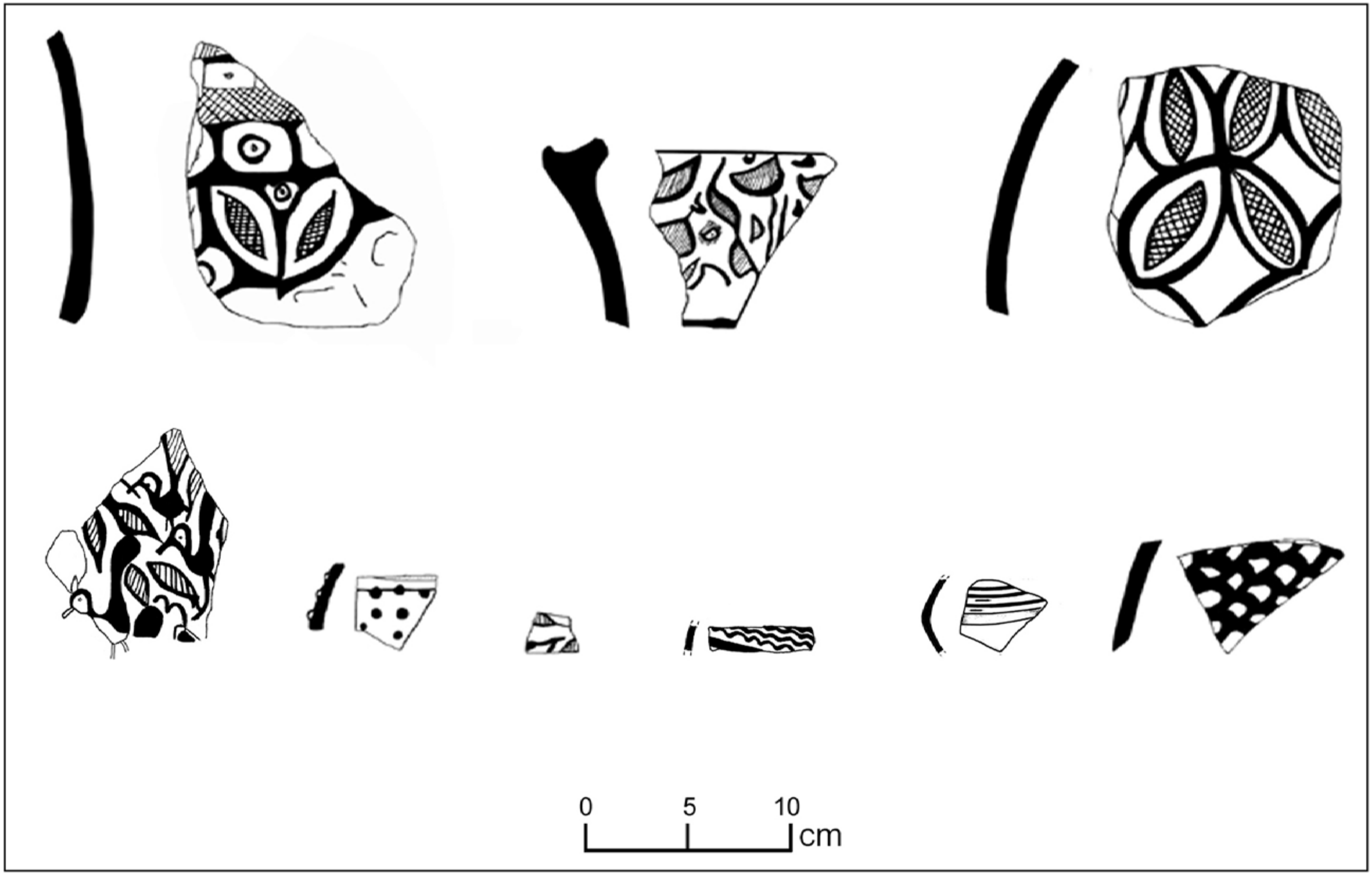
Painted pottery from stage IV

Fig. 7.30: Painted Pottery types from Stage IV, Dholavira



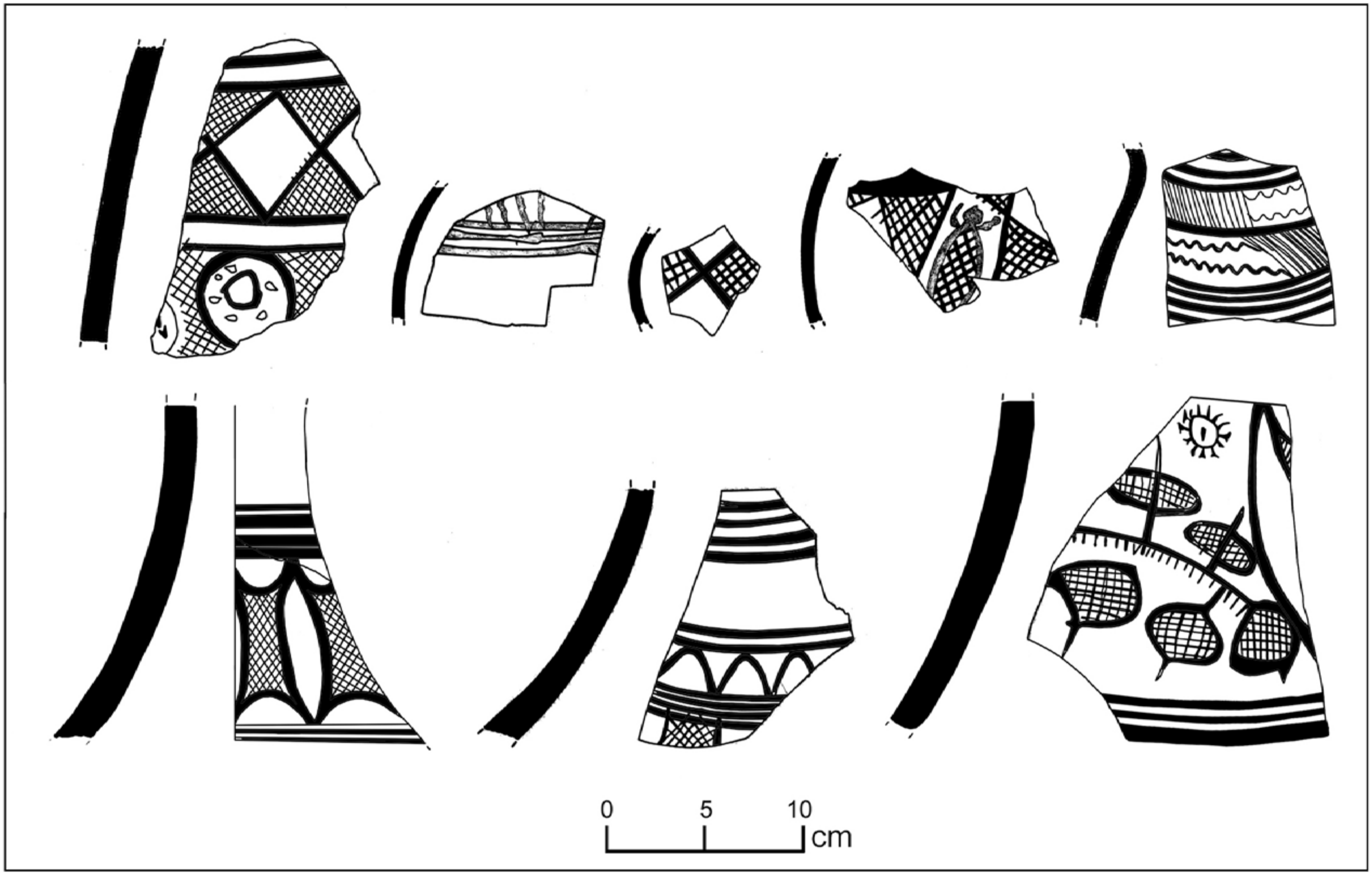
Painted pottery 1, 3, 6 & 8 are from Stage IV; remaining are from Stage V.

Fig. 7.31: Painted Pottery types from Stage IV, Dholavira



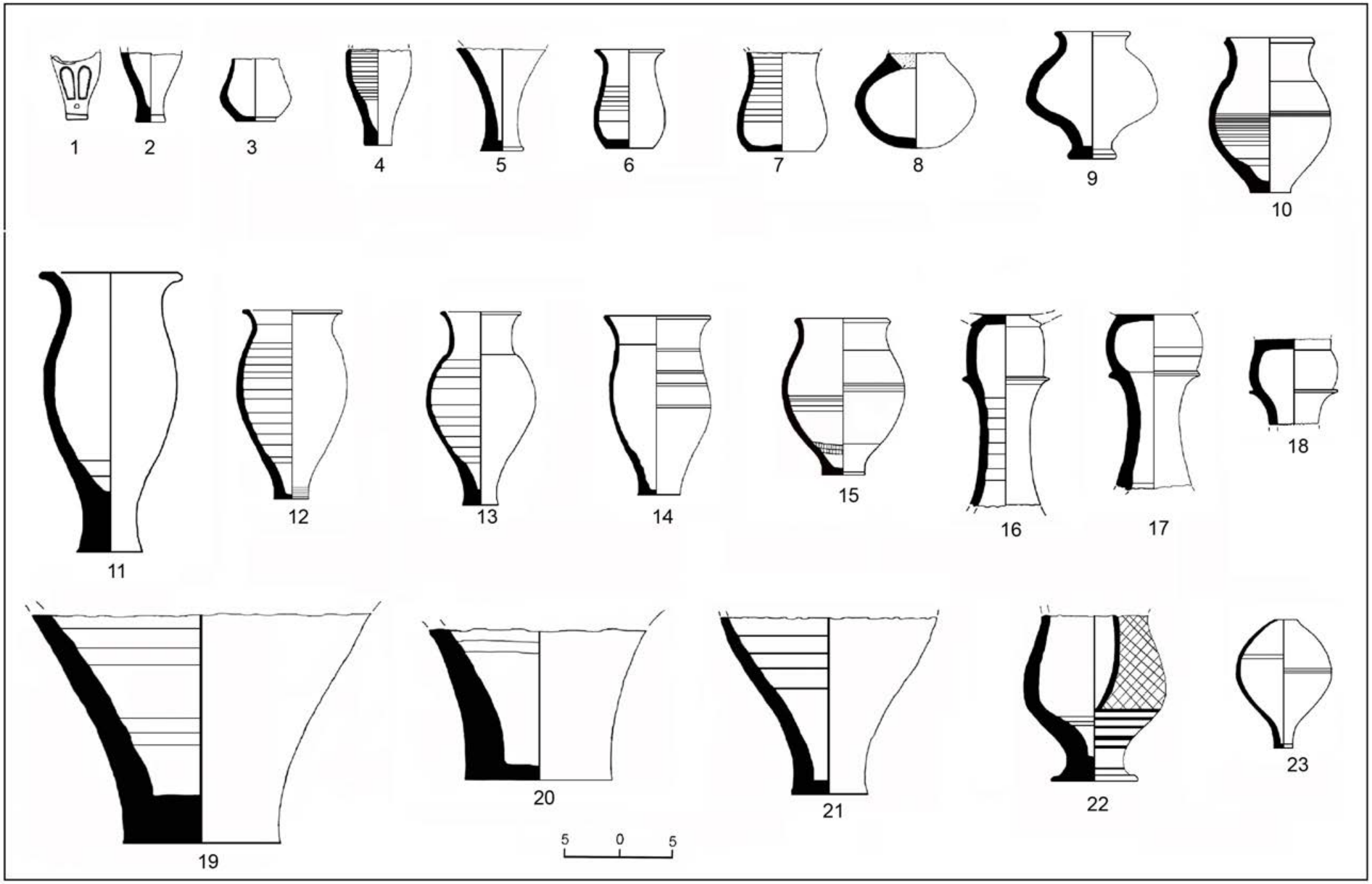
Painted pottery from Stage IV

Fig. 7.32: Painted Pottery types from Stage IV, Dholavira



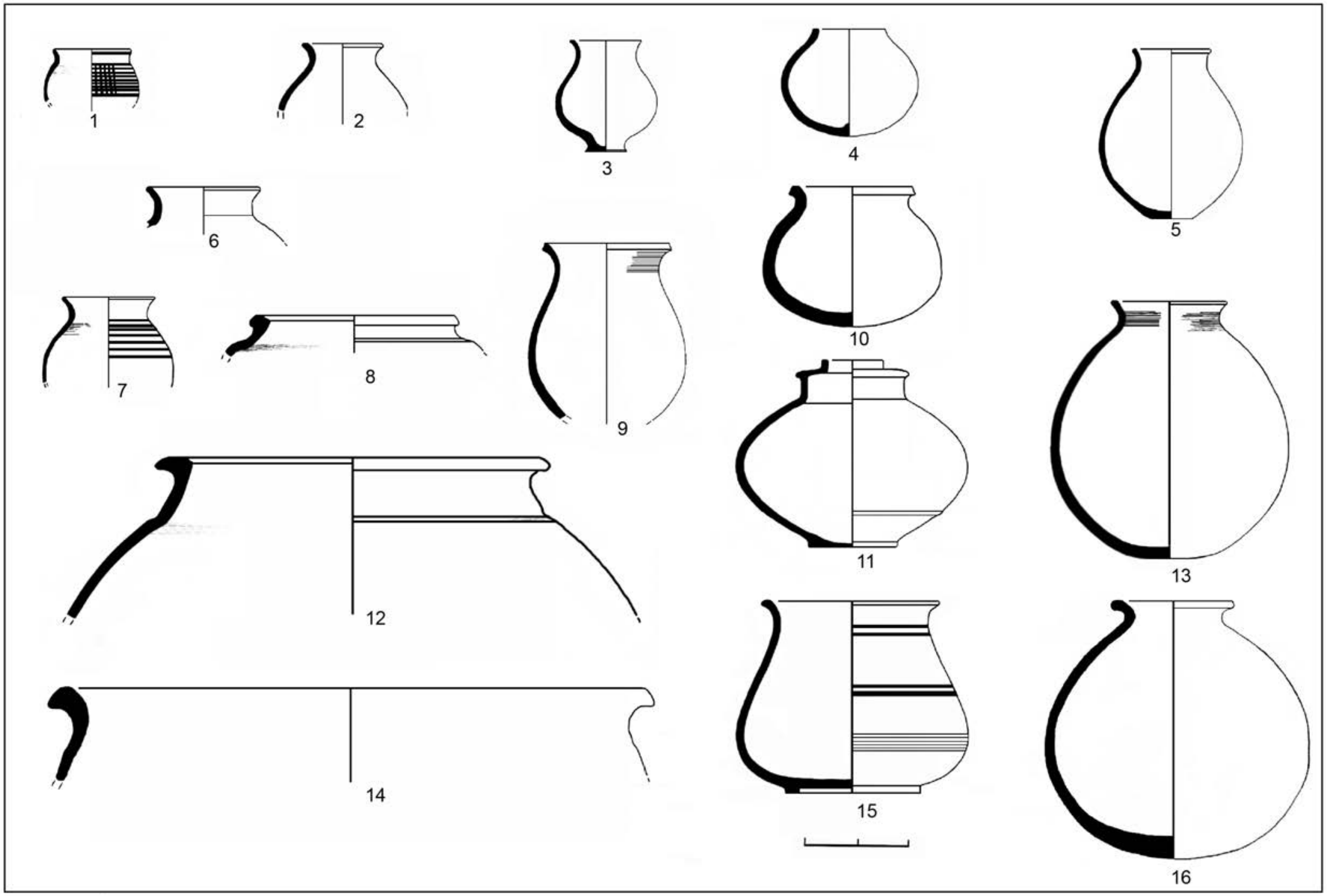
Painted pottery from Stage IV

Fig. 7.33: Painted Pottery types from Stage IV, Dholavira



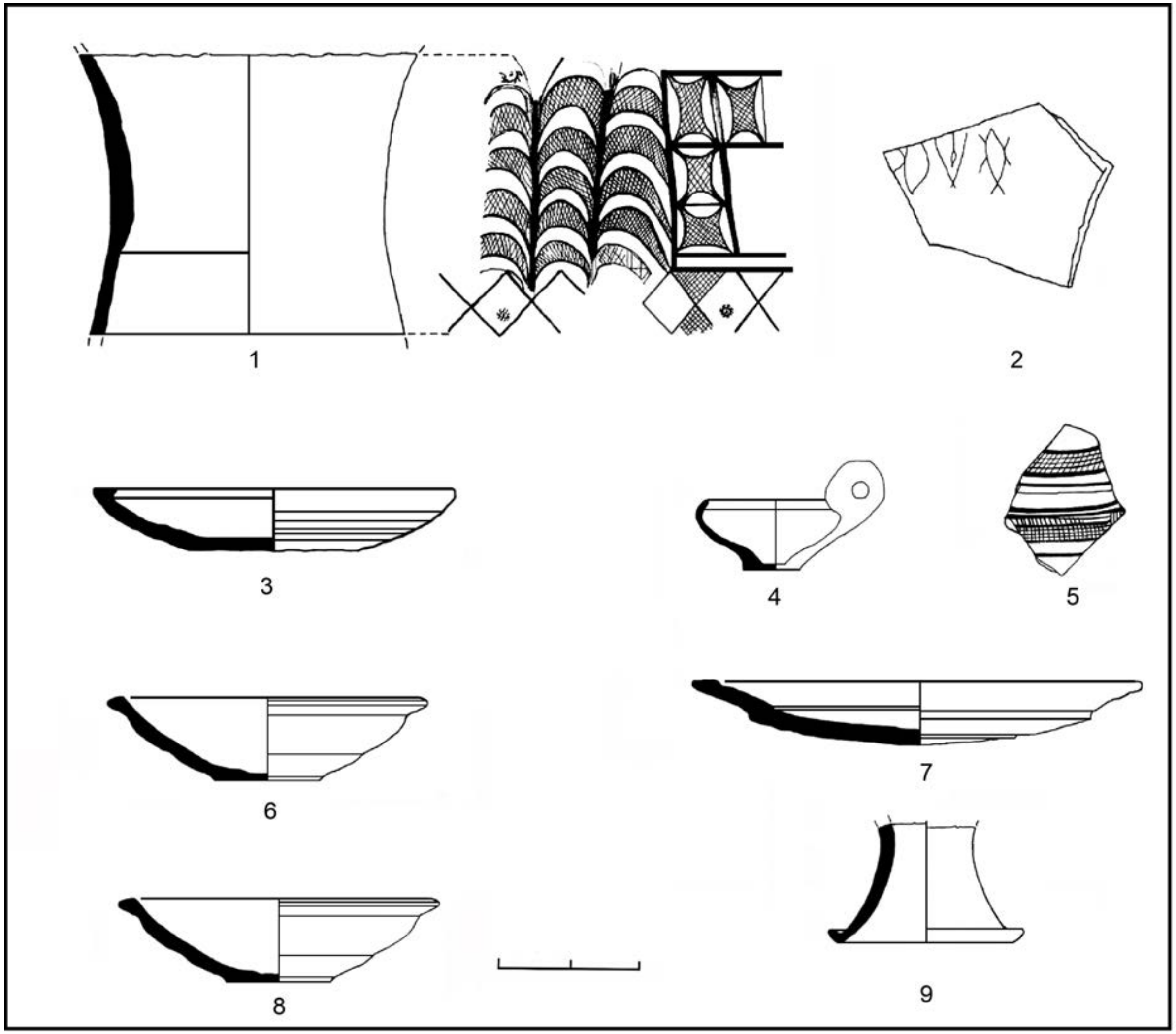
Pottery of Stage V: 1-2,4-5, 11-14: Goblets of red ware with non-contiguous solid bases; 3: small jar; 6-7: beakers; 8: small pot with broken rim; 9: small jar with non-contiguous solid base; 10, 15: jars with non-contiguous base; 16-18: central portion of a dish on stand (broken) with cylindrical ridged stem; 19-21: contiguous base of large storage jars; 22: base of a pot-on-stand; 23: small jar with pointed base

Fig. 7.34: Pottery types from Stage V, Dholavira



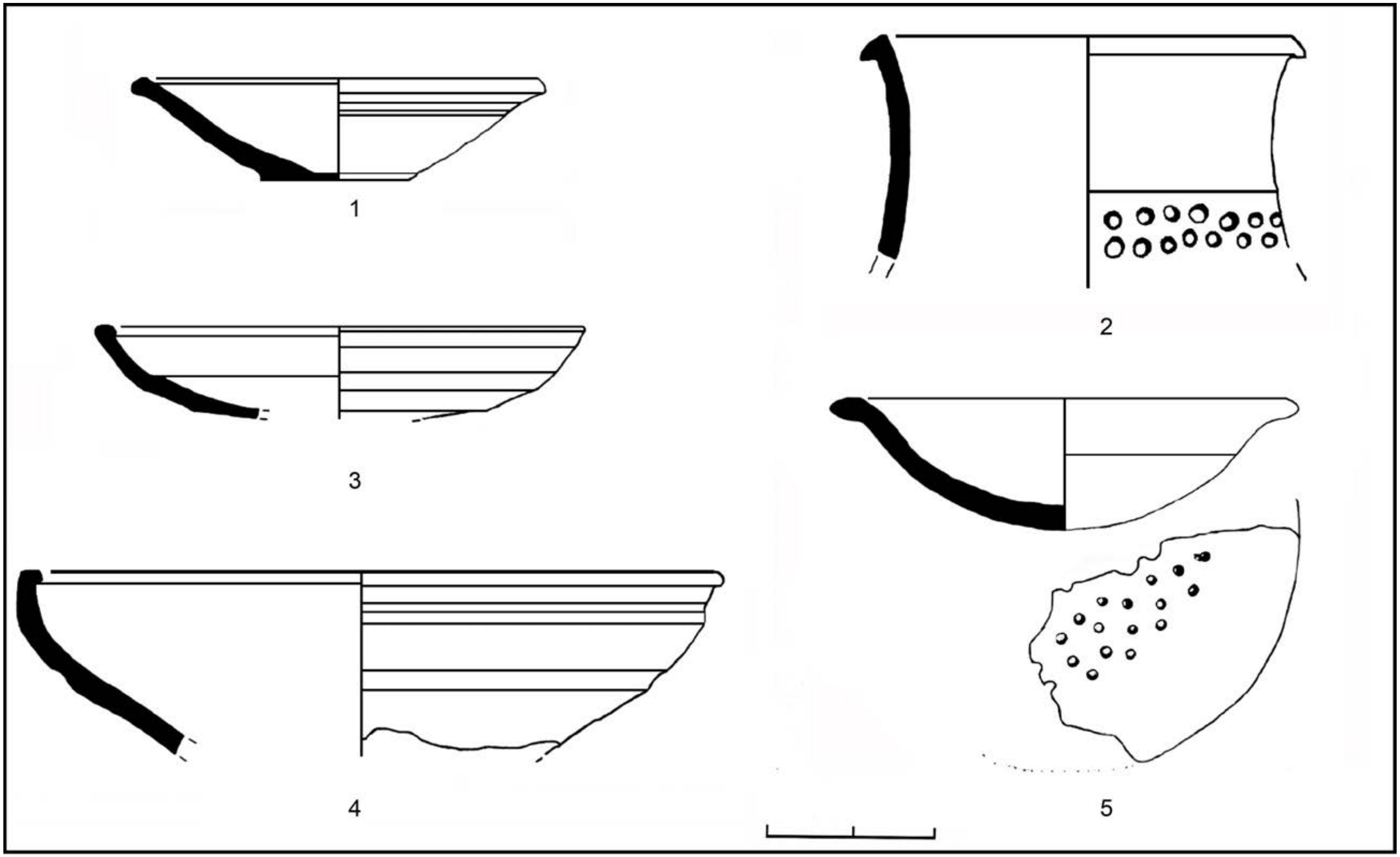
Pottery of Stage V: 1-4, 6-7, 10: Pots of red ware of simple everted rims, some with black coloured painted motifs on the shoulder consisting of horzontal and vertical bands; 5,9: Jars of red ware; 8,12-13, 16: Storage jars with simple everted to beaked rims, 12 of the typical Harappan shape with a short neck and carinated profile; 11: pot with a straightened neck and provision at the mouth to hold a lid; 14: wide mouthed storage vessel; 15: wide mouthed jar with a non-contiguous base and horizontal banded decorations

Fig. 7.35: Pottery types from Stage V, Dholavira



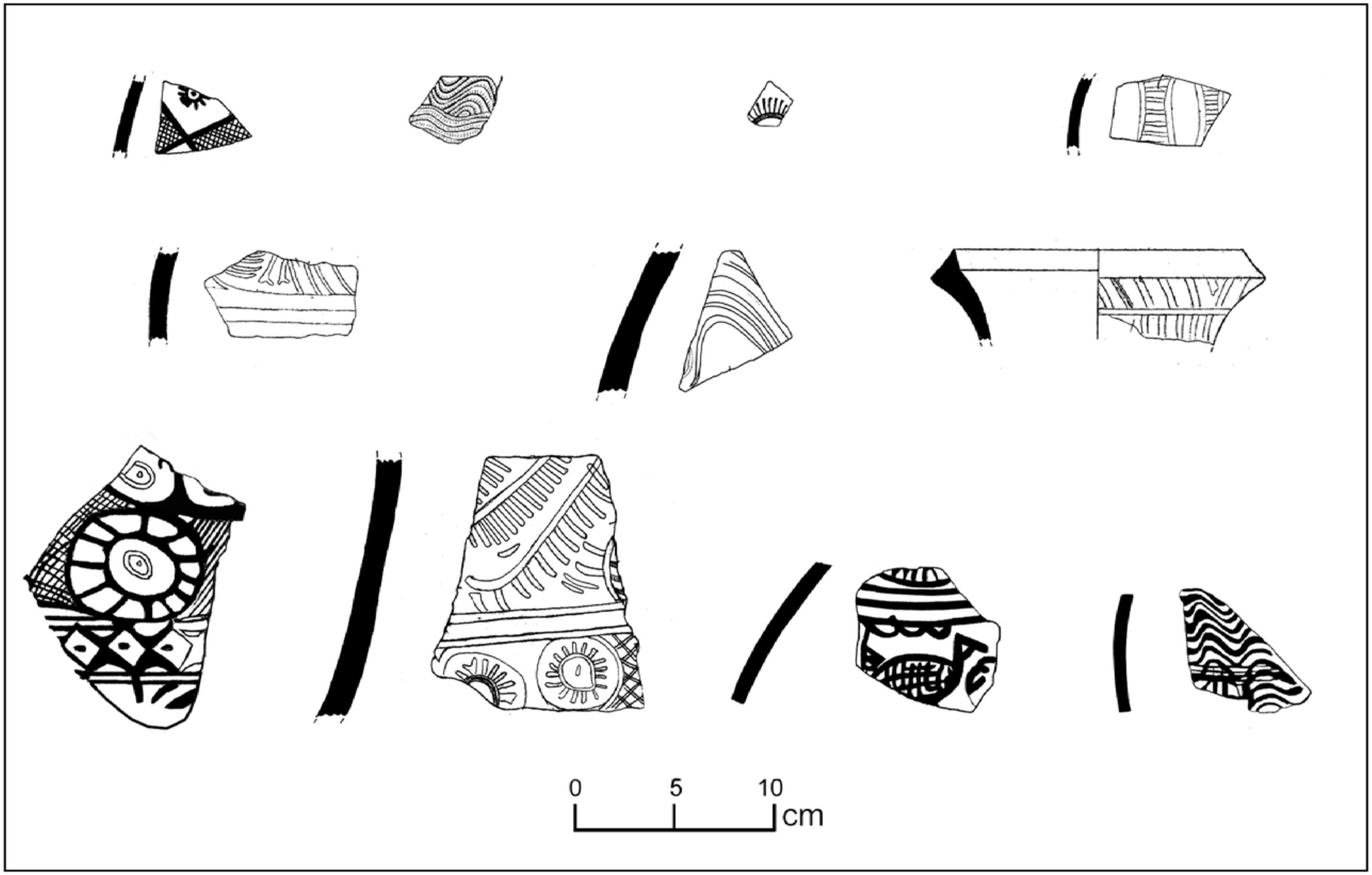
Pottery of Stage V: 1,5: Red ware Non diagnostic painted sherds(cross hatched leaf pattern and diagonally sub divided squares with alternately hatched triangles), 2: body of a jar with Harappan letters as graffiti, 3, 6-8: dishes (complex, bilateral projecting, more external projecting rims, with corrugated and carinated body, contiguous flat base), 4: bird feeding cup: simple, inverted rim, convex sides, non contiguous discoid base and pinched perforated handle), 9: dish on stand (non contiguous, high pedestal base)

Fig. 7.36: Pottery types from Stage V, Dholavira



Pottery of Stage V: 1,3-4: Dishes of red ware, one with everted rim and remaining (3-4) with slighly inward turning rims; 2: perforated jar with a straight and beaked rim; 5: bowl of red ware with perforations

Fig. 7.37: Pottery types from Stage V, Dholavira



Painted pottery from stage V

Fig. 7.38: Painted Pottery types from Stage IV, Dholavira



Fig. 7.39: Pottery types from Stage V, Dholavira



Fig. 7.40: Pottery types from Stage V, Dholavira



Fig. 7.41: Pottery types from Stage V, Dholavira



Fig. 7.42: Pottery types from Stage V, Dholavira



Fig. 7.43: Pottery types from Stage V, Dholavira



Fig. 7.44: Pottery types from Stage V, Dholavira



Fig. 7.45: Black slipped jar, Dholavira

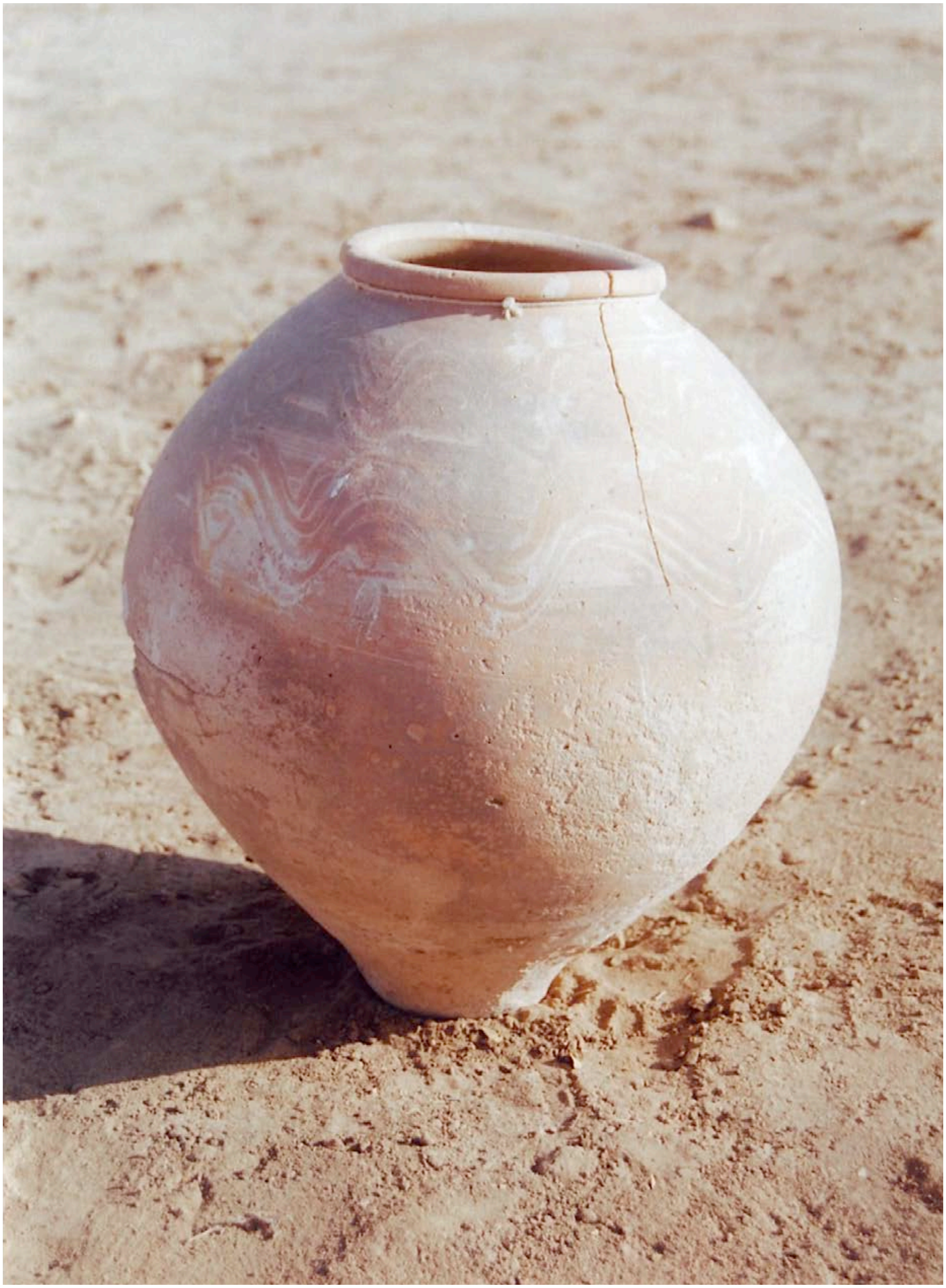
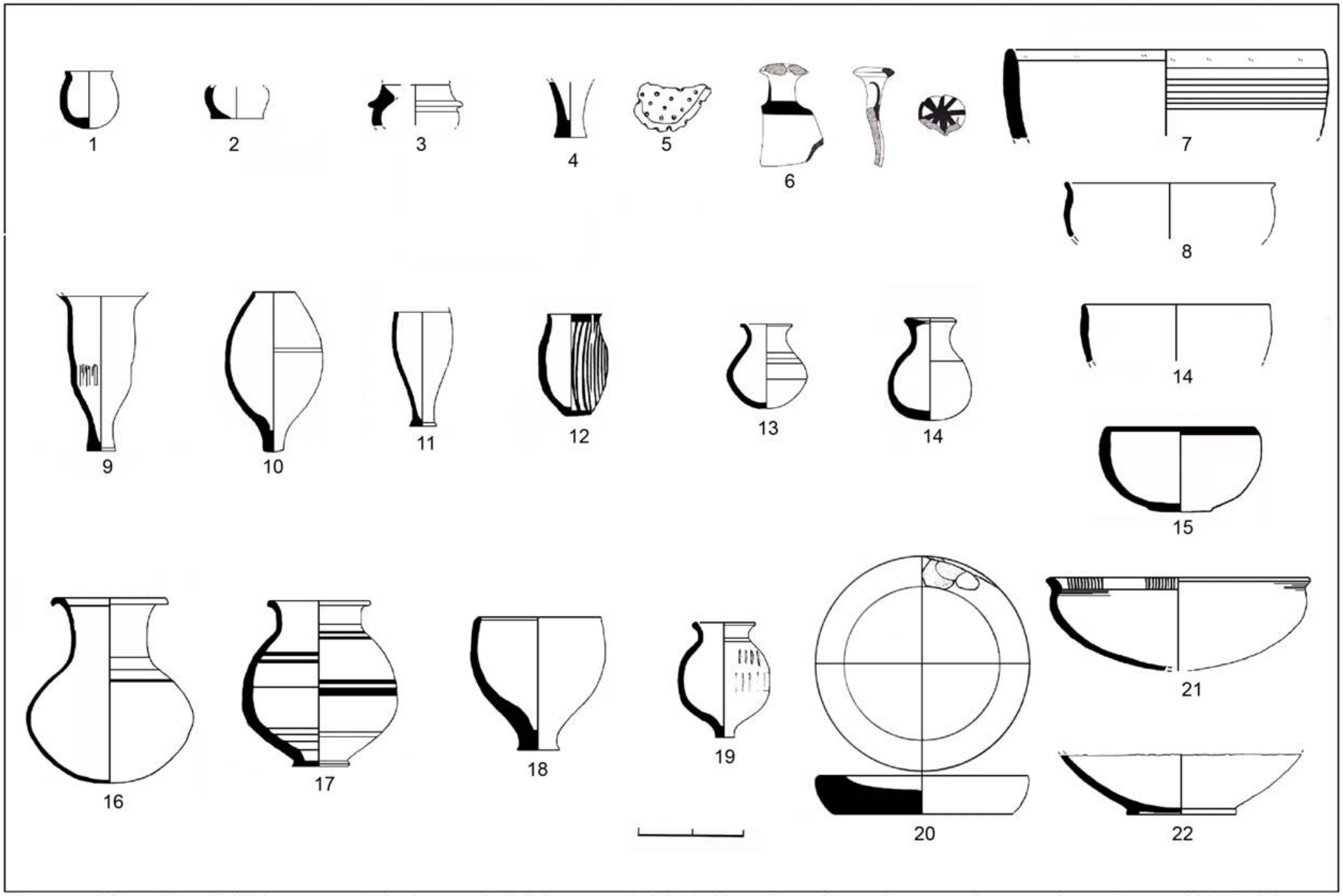
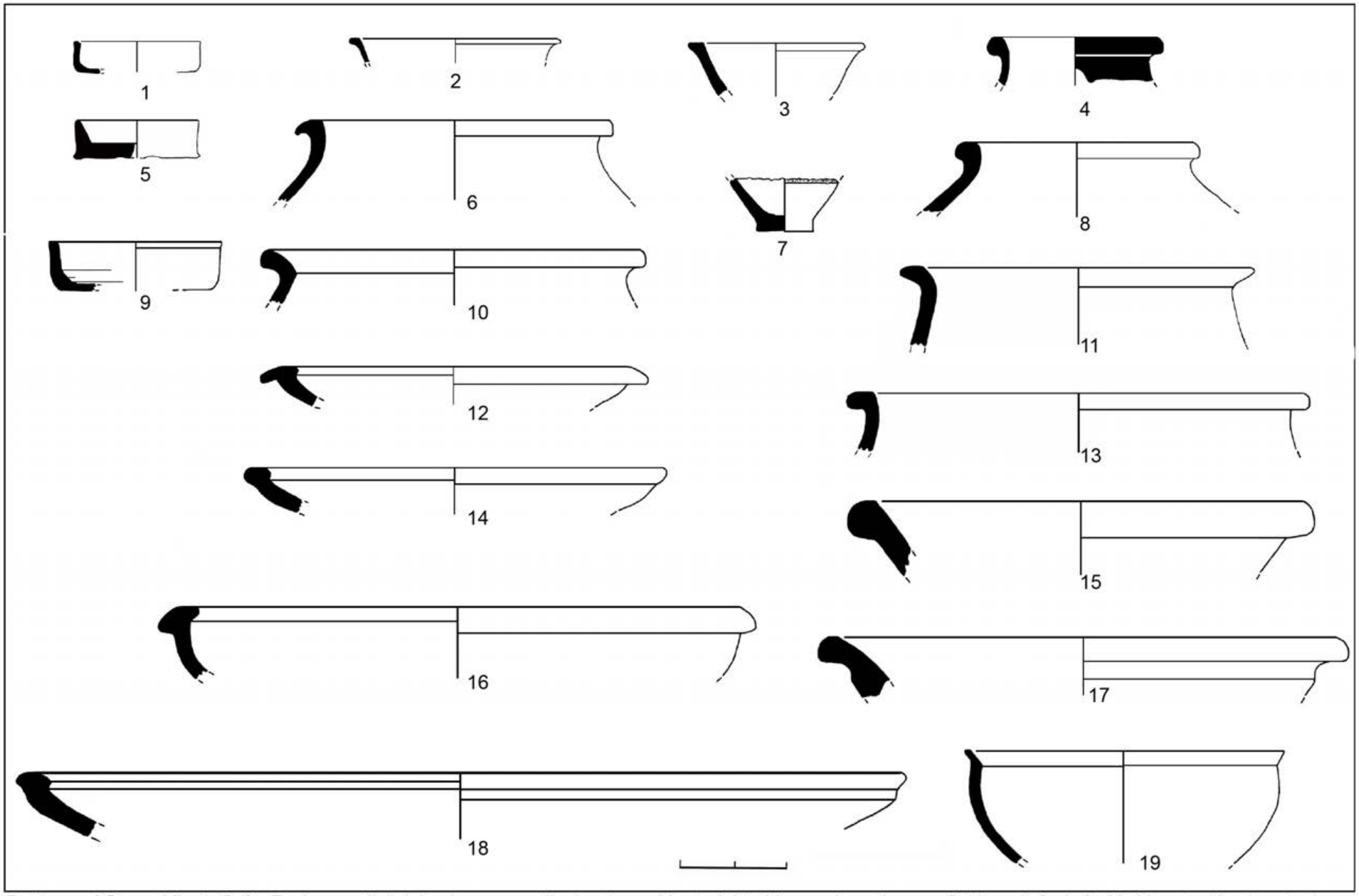


Fig. 7.46: Storage Jar from Stage V, Dholavira



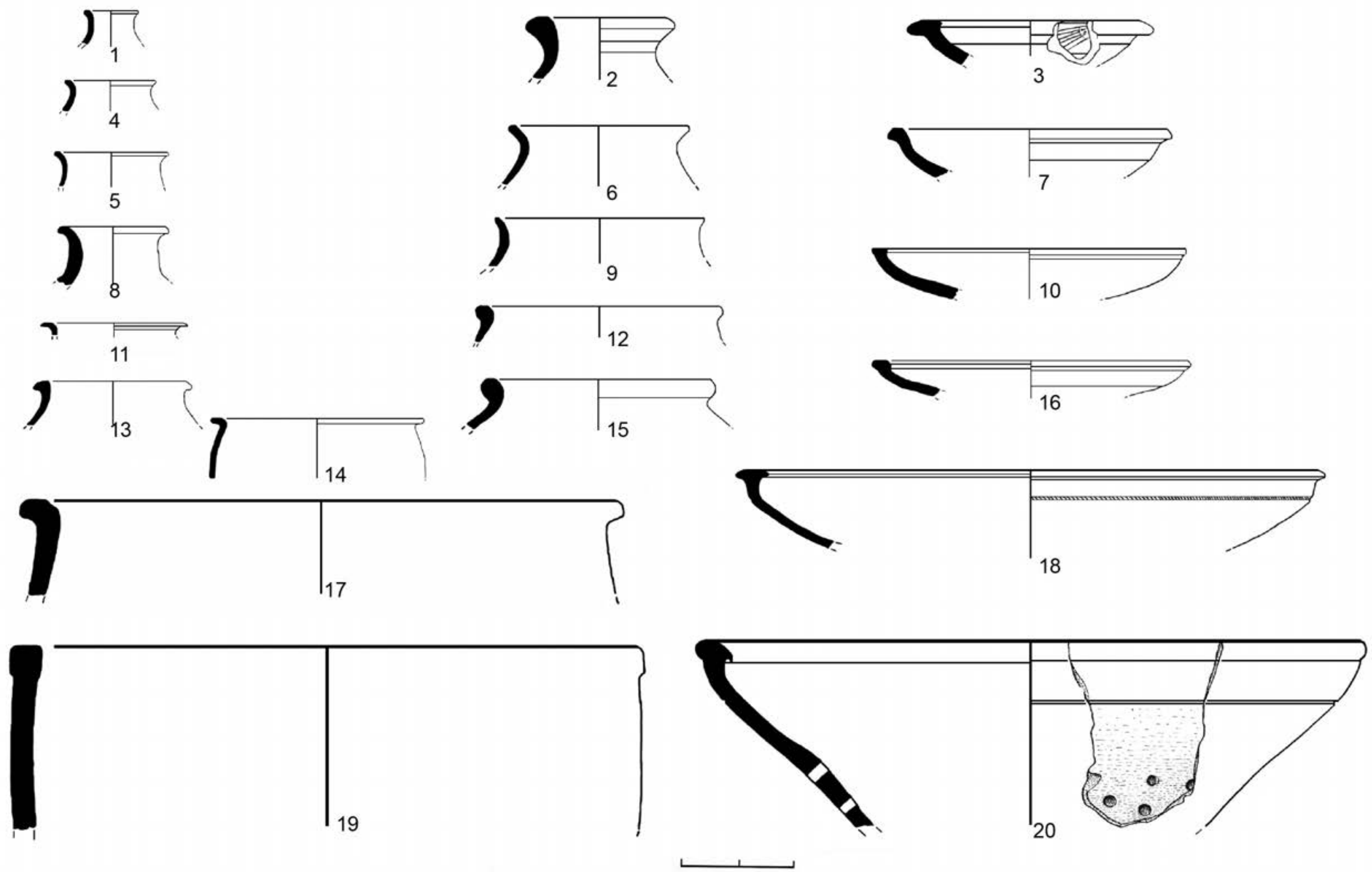
Pottery of Stage VI: 1-2: Miniature pots; 3: broken trunk of dish-on-stand; 4,9-11, 18: goblets with contiguous and non-continuous bases; 12-14: miniature pots / jars; 16-17, 19: jars, with decorations consisting horizontal bands; 5: fragment of a perforated pot, 6: stud handle bowl (concave sided bowl with simple everted rim, a stud attached to the rim with a radial pattern painted on the top; 7-8, 14: bowls of red ware with simple to everted rims; 15, 21-22: bowls with non-contiguous and contiguous bases, with simple to everted rims; 20: sturdy dish

Fig. 7.47: Pottery types from Stage VI, Dholavira



Pottery of Stage VI: 1, 5, 9 : Red ware dish (simple, perpendicular rims with straight sides and contiguous flat base), 2, 4, 6, 10-11: pots / jar (everted external projecting, round, beaked rim, globular or bulbous body), 3, 15, 17, 19: bowls with simple to slightly everted rims, thin as well as thick cores: 12, 14, 16, 18: Dishes with everted, beaked as well as internally projecting rims; 13: wide mouthed pot; 7: base of jar with non-contiguous

Fig. 7.48: Pottery types from Stage VI, Dholavira



Pottery of Stage VI: 1-2, 4-6, 8-9, 11-13, 15: Redware pots / jars (external projecting, everted, beaked and rounded rims, bulbous or globular body); 3, 7, 10, 16, 18: dish (complex, bilateral projecting, more external and internal projecting rims, with and without corrugated body and contiguous flat base), 14: bowl with slightly everted and beaked rim: 17, 19: wide mouthed bowls with beaked and everted rims; 20: bowl with perforations with bilaterally projecting beaked rim

Fig. 7.49: Pottery types from Stage VI, Dholavira


Fig. 7.50: Pottery types from Stage VI, Dholavira


Fig. 7.51: Pottery types from Stage VI, Dholavira



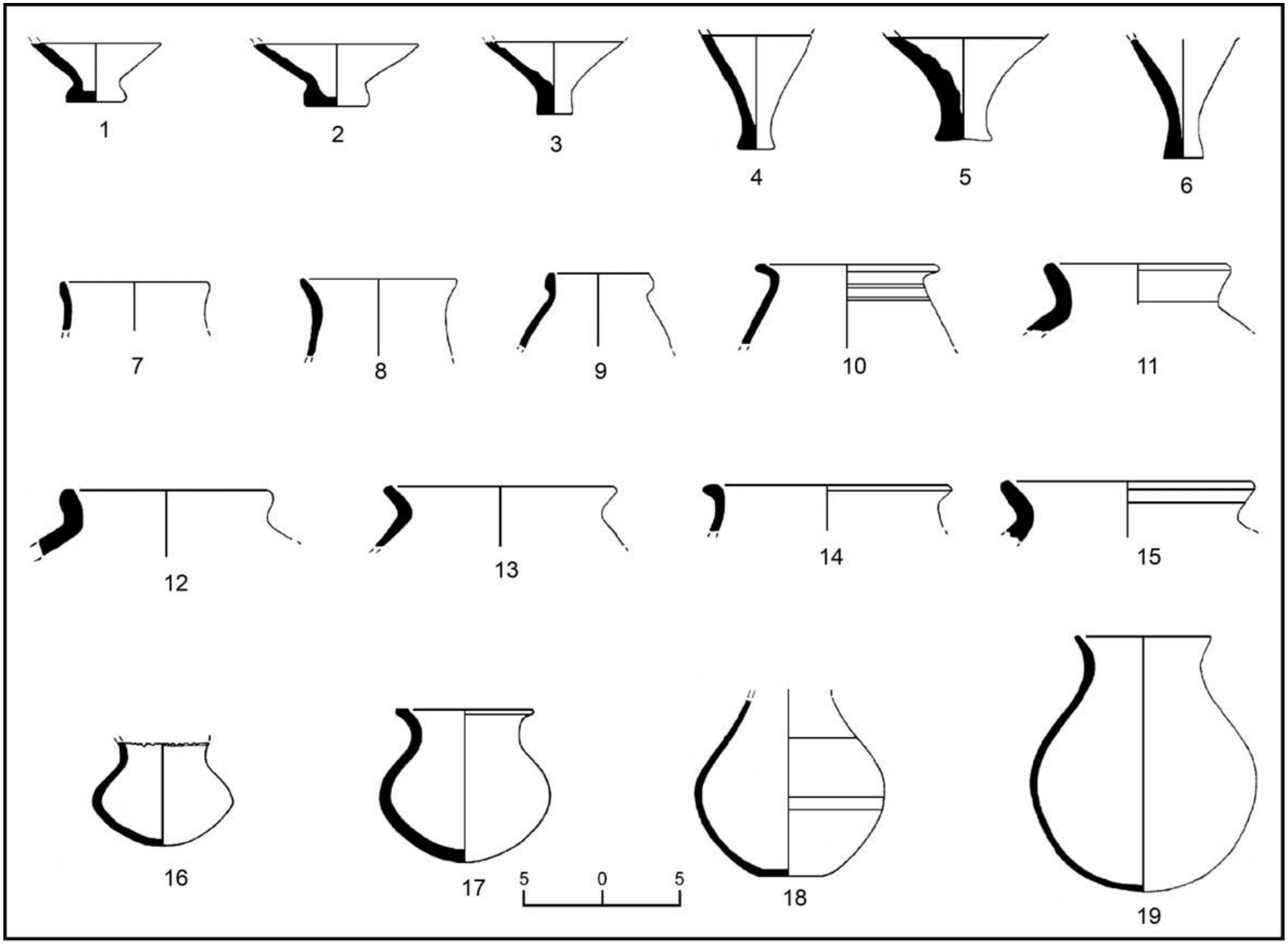
Fig. 7.52: Pottery types from Stage VI, Dholavira



Fig. 7.53: Pottery types from Stage VI, Dholavira

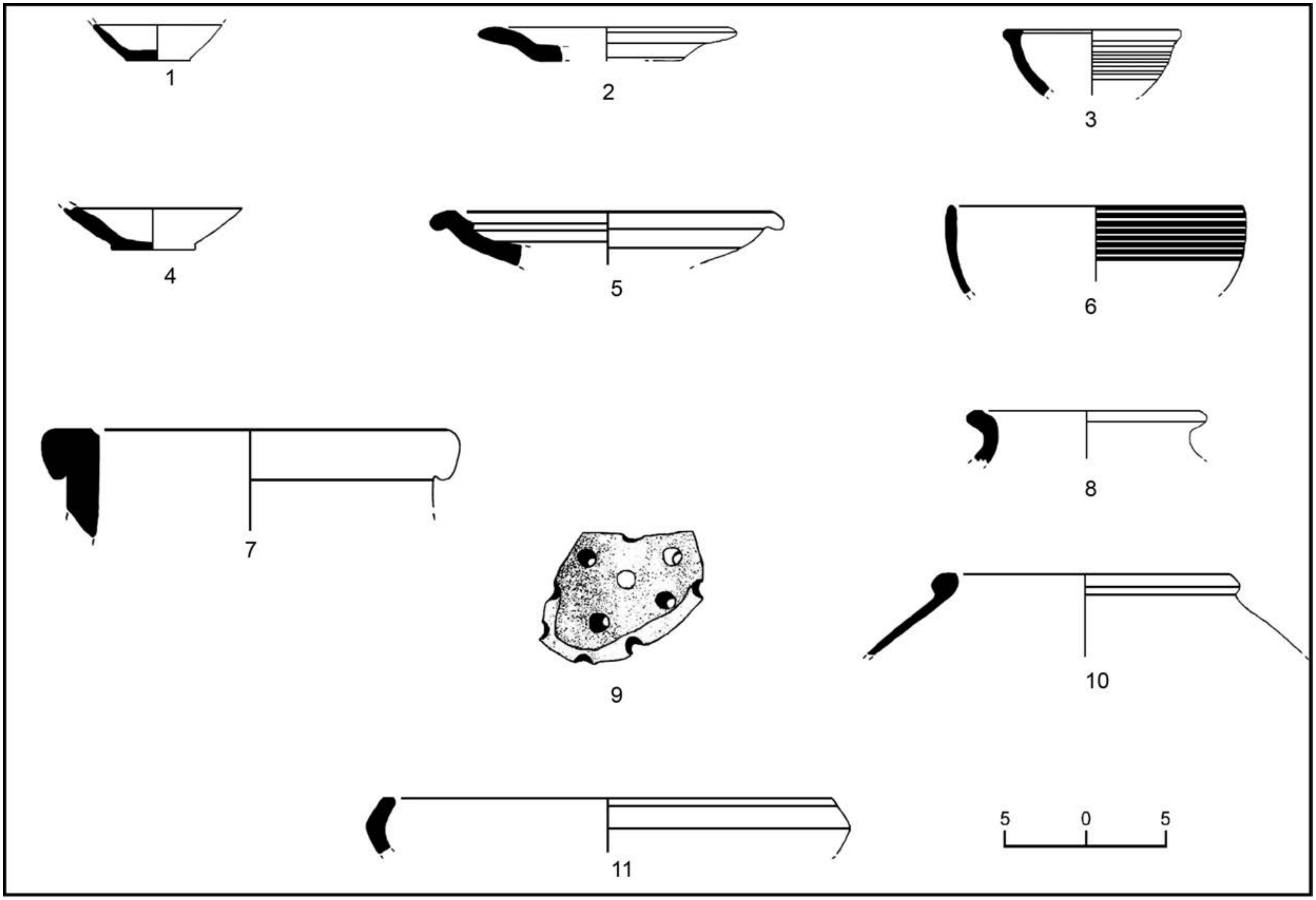


Fig. 7.54: Examples of Reserved Slip Ware, Dholavira



Pottery of Stage VII: 1-6: Red ware goblet (non contiguous narrow solid base), 7-15, 16- 19: pots (with simple, external projecting and everted rims, globular or bulbous body)

Fig. 7.55: Pottery types from Stage VII, Dholavira



Pottery of Stage VII: 1, 4: bases (contiguous concave and flat), 2, 5: dish (with simple, externally projecting rim and contiguous flat base); 3, 6, 11: bowl (simple, everted and internal projecting rim and convex sides); 7: rim of a jar, thick and everted, beaked; 9: fragment of perforated jar; 8, 10: pots (with simple, external projecting and everted rims, globular or bulbous body)

Fig. 7.56: Pottery types from Stage VII, Dholavira

Antiquities

The excavation at Dholavira brought to light a large number of artefacts and so far a total number of 54276 artefacts have been accessioned. The presence of artefacts is noticed right from Stage I onwards up to Stage VII. The artefact categories consist of a multitude of varieties including seals and sealings, beads, bangles, blades, chisels, arrowheads, grinding stones, stone members, inlay pieces, etc. A variety of materials were used to fashion the artefacts at Dholavira.

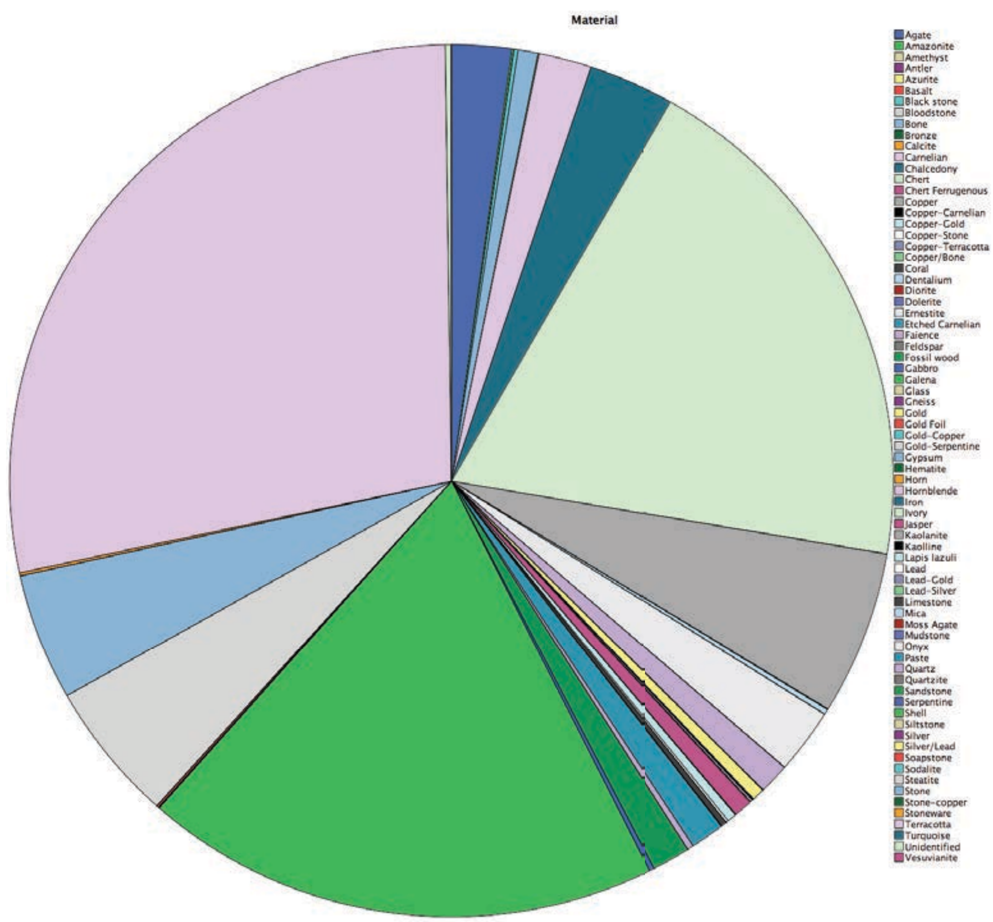


Fig. 8.1: Pie chart showing the distribution of materials for artefacts

A material wise analysis of artefacts was carried out for all categories of artefacts of all periods. A total of 75 materials of all major and minor categories have been used to fashion the artefacts. This indicates the diversity and availability of choice of materials for the Harappans at Dholavira. Among the materials, artefacts of terracotta dominate with a total number of 15272 (28.1%) followed by chert (10550, 19.1%), shell (10261, 18.9%), copper (3295, 6.1%), steatite (2812, 5.2%), unidentified stones (2557, 4.7%), chalcedony (1700, 3.1%), agate (1187, 2,2%), carnelian (1048, 1.9%), ernestite drill bits for perforating the beads (1607, 2.4%). The remaining materials are in a minor percentage. However, among the stone raw materials of exotic in nature, mention should be made to moss agate, vesuvianite, turquoise, bloodstone, jasper, lapis lazuli, onyx, quartz, serpentine, amazonite, amethyst. The detail material wise representation is shown in the following table:

	Material					
			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.	Agate	1187	2.2	2.2	2.2
	2.	Amazonite	32	.1	.1	2.2
	3.	Amethyst	2	.0	.0	2.2
	4.	Antler	2	.0	.0	2.3
	5.	Azurite	1	.0	.0	2.3
	6.	Basalt	7	.0	.0	2.3
	7.	Black stone	79	.1	.1	2.4
	8.	Bloodstone	1	.0	.0	2.4
	9.	Bone	395	.7	.7	3.1

	10.	Bronze	23	.0	.0	3.2
	11.	Calcite	1	.0	.0	3.2
	12.	Carnelian	1048	1.9	1.9	5.1
	13.	Chalcedony	1700	3.1	3.1	8.3
	14.	Chert	10550	19.4	19.4	27.7
	15.	Chert Ferrugenous	4	.0	.0	27.7
	16.	Copper	3295	6.1	6.1	33.8
	17.	Copper-Carnelian	1	.0	.0	33.8
	18.	Copper-Gold	7	.0	.0	33.8
	19.	Copper-Stone	3	.0	.0	33.8
	20.	Copper-Terracotta	1	.0	.0	33.8
	21.	Copper/Bone	1	.0	.0	33.8
	22.	Coral	1	.0	.0	33.8
	23.	Dentalium	106	.2	.2	34.0
	24.	Diorite	3	.0	.0	34.0
	25.	Dolerite	1	.0	.0	34.0
	26.	Ernestite	1307	2.4	2.4	36.4
	27.	Etched Carnelian	6	.0	.0	36.4
	28.	Faience	607	1.1	1.1	37.5
	29.	Feldspar	2	.0	.0	37.5
	30.	Fossil wood	1	.0	.0	37.5
	31.	Gabbro	4	.0	.0	37.5
	32.	Galena	1	.0	.0	37.5
	33.	Glass	2	.0	.0	37.6

	34.	Gneiss	1	.0	.0	37.6
	35.	Gold	250	.5	.5	38.0
	36.	Gold Foil	1	.0	.0	38.0
	37.	Gold-Copper	16	.0	.0	38.0
	38.	Gold-Serpentine	1	.0	.0	38.0
	39.	Gypsum	6	.0	.0	38.1
	40.	Hematite	4	.0	.0	38.1
	41.	Horn	7	.0	.0	38.1
	42.	Hornblende	40	.1	.1	38.2
	43.	Iron	2	.0	.0	38.2
	44.	Ivory	17	.0	.0	38.2
	45.	Jasper	369	.7	.7	38.9
	46.	Kaolinite	2	.0	.0	38.9
	47.	Kaolin	11	.0	.0	38.9
	48.	Lapis lazuli	182	.3	.3	39.2
	49.	Lead	49	.1	.1	39.3
	50.	Lead-Gold	1	.0	.0	39.3
	51.	Lead-Silver	1	.0	.0	39.3
	52.	Limestone	112	.2	.2	39.5
	53.	Mica	1	.0	.0	39.5
	54.	Moss Agate	1	.0	.0	39.5
	55.	Mudstone	1	.0	.0	39.5
	56.	Onyx	8	.0	.0	39.5
	57.	Paste	674	1.2	1.2	40.8
	58.	Quartz	126	.2	.2	41.0

	59.	Quartzite	2	.0	.0	41.0
	60.	Sandstone	757	1.4	1.4	42.4
	61.	Serpentine	98	.2	.2	42.6
	62.	Shell	10261	18.9	18.9	61.5
	63.	Siltstone	9	.0	.0	61.5
	64.	Silver	11	.0	.0	61.5
	65.	Silver/Lead	1	.0	.0	61.5
	66.	Soapstone	38	.1	.1	61.6
	67.	Sodalite	6	.0	.0	61.6
	68.	Steatite	2812	5.2	5.2	66.8
	69.	Stone	2557	4.7	4.7	71.5
	70.	Stone-copper	1	.0	.0	71.5
	71.	Stoneware	61	.1	.1	71.6
	72.	Terracotta	15272	28.1	28.1	99.8
	73.	Turquoise	5	.0	.0	99.8
	74.	Unidentified	115	.2	.2	100.0
	75.	Vesuvianite	6	.0	.0	100.0
		Total	54276	100.0	100.0	

8.1 Inscriptions

Literacy of the Harappans is best examplified in their inscriptions written in a script that is unparalleled in its characters hitherto unknown and undeciphered so far. These inscriptions are best represented on their seals and seals-impressions in addition to those engraved or painted on the objects of metal, terracotta, pottery, faience, ivory, bone and stone, albeit sometimes appearing in a single sign inscription or scratching particularly on pottery or terracotta objects.

8.1.1 Signboard

One of the most prominent discoveries from the excavations at Dholavira is the find of a 10 large sized signboard presently lying in the western chamber of North Gate. This inscription was found lying in the western chamber of north gate, and the nature of find indicate that it could have been fitted on a wooden signboard, most probably fitted above the lintel of the central passageway of the gate.

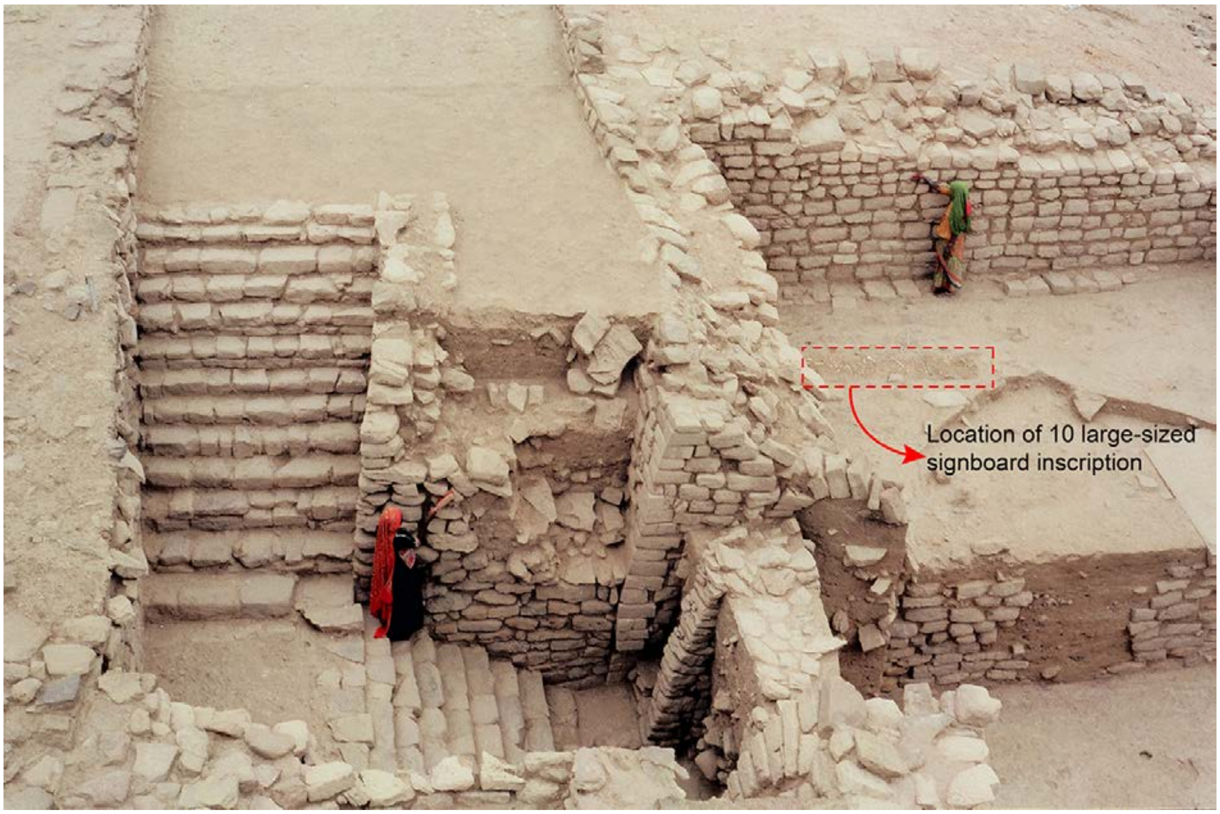


Fig. 8.2: Location of ten large sized inscription in North Gate



Fig. 8.3: Close-up of the inscription

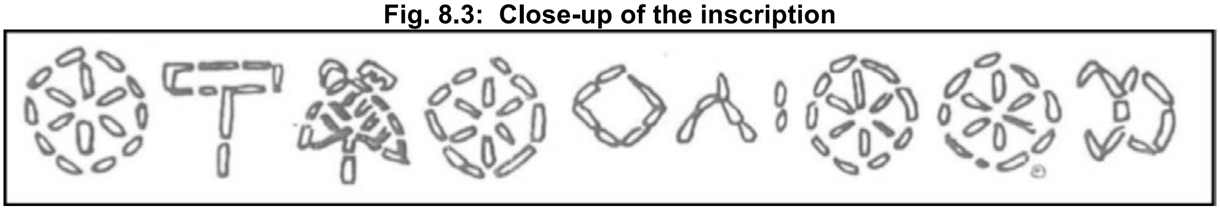


Fig. 8.4: Drawing showing the ten letters of inscription

The central passageway of north gate itself measures 3.5 m in width and the length of the inscription along with the wooden frame impression is also more or less same thereby indicating the probable location. The inscription consists of 10 large-sized letters of the typical Harappan script, and is actually gypsum inlays cut into various sizes and shapes, which were utilized to create each size as, indicated above. The exact meaning of the inscription is not known in the absence of decipherment of the script.



Fig. 8.5: Photograph showing the details of inscription *in situ*



Fig. 8.6: Close-up of some of the letters from the inscription



Fig. 8.7: Gypsum inlays used for the inscription

8.1.2 Inscription on a stone block

Another instance of an inscription is noticed from a secondary context in one of the four square underground chambers found at the southern portion of Bailey. The inscription consisting of four letters was found on the shorter face of a portion of what could be a large rectangular limestone slab, originally a lintel of a doorway.



Fig. 8.8: Inscription on a stone block from Bailey, Dholavira

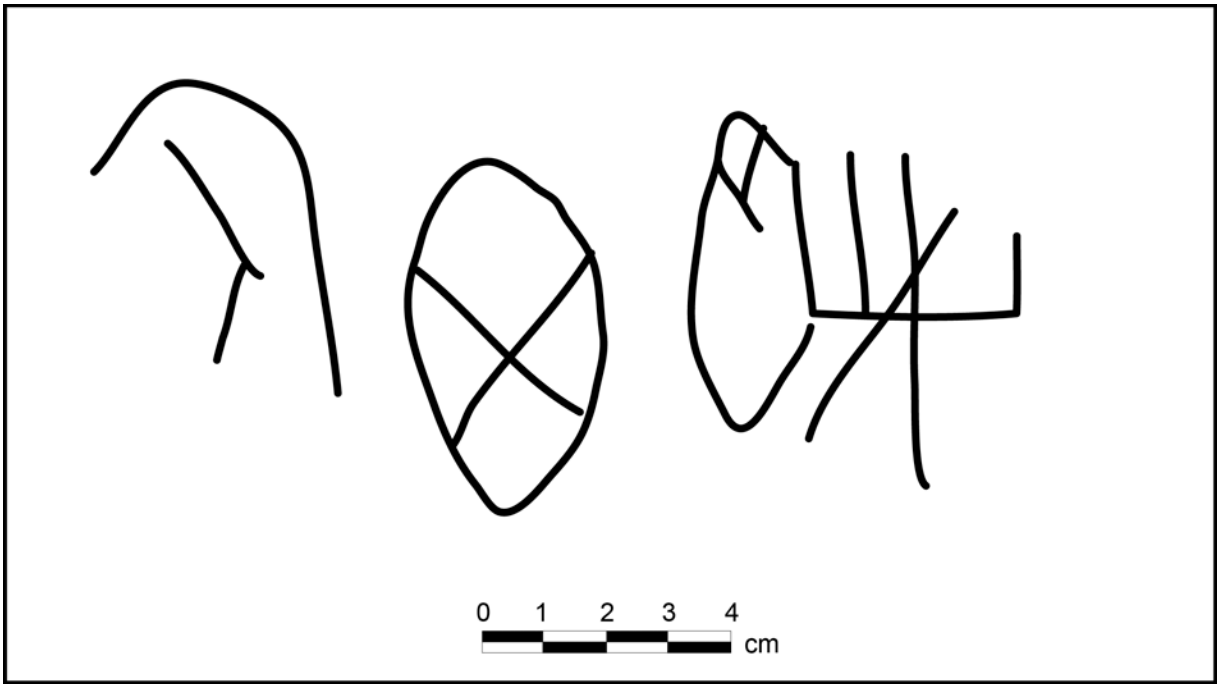


Fig. 8.9: Drawing of the inscription found on a stone block, Bailey

The stone block is badly eroded and peeling off in layers could be noticed. The inscription consists of four letters partially preserved due to the eroding nature of the stone. As the stone member was found fixed in masonry of the square underground chambers, it can be deduced that it could have been damaged and hence used as part of a masonry as its original meaning might have been lost. The extant length of the inscription is 16.5 cm while the width is 8 cm. The inscription consists of four letters, while three letters are clearly visible, the fourth one towards the left end is not clearly visible.

8.1.3 Graffitti from the excavations

Another evidence of literate Harappans is gleaned from several examples of graffitti from pottery, terracotta cakes, stoneware bangle, etc. These graffitti belong to the typical Harappan signs and in a few cases complete inscriptions in the form of two or more signs have been depicted together. An interesting example of graffiti is from a stoneware bangle fragment, which might indicate that it could be a kind of ownership record.



Fig. 8.10: Graffitti found on various mediums

8.2 Seals and Sealings

During the course of excavation at Dholavira, 225 seals and 60 sealings have been recovered. For better appreciation of types and nature of seals and their temporal and spatial growth and distribution at Dholavira, the findings should be understood with the overall growth and development of the city itself. The sequential growth in terms of sigillography is given below:

Stage	Motif	Inscription	Shape
IIIA	Geometric and mythological	Not present	Square with rudimentary perforated boss
IV & V	Usual Harappan motifs	Yes	Square with classical and sub-classical boss Rectangular ones in upper levels
VI	Not present	Yes	Plano-convex with rectangular face; convex, rounded, triangulated or wagon-vaulted back with a perforation

No evidence of seals, sealings and tablets or evidence of writing was found during Stages I, II and VII so far. However, potter's marks are occasionally present in the first two. First appearance of seals occurred in Stage III with only one tiny specimen seals. This early seal of steatite are smaller in size, lighter in weight, thinner in section, and furnished with a rudimentary perforated boss at the back there are no inscriptions on this seal although the script had evolved as evidenced from a potsherd bearing three Harappan signs written in black pigment. The seal is depicted with a mythological scene which is closely similar to the one depicted on Mohenjo-daro seal (M-1186A-CISI-Vol. 2). The scene exhibits an iconographic elaboration of the same theme that occurs on the Dholavira example its early evolutionary stage. The same theme has been repeated on seals and terracotta tablets at Mohenjo-daro and Harappa. In Stage IV and V (Harappan), there is a phenomenal increase in seals, bearing iconography and inscriptions, and usually executed deftfully showing all such features, which mark the Harappan sigillography everywhere else in the mature phase at a number of contemporary sites.



Fig. 8.11: Example of seal from Stage III

The majority of the seals are of steatite of different hues and textures. Usually most of them are baked hard, although a new unbaked ones or lightly hardened are also present. A few seals are of terracotta or other stones. The most commonly used raw material for seals was steatite of various shades (black, khaki, grey and green ones are most common), and the most preferred one was the white steatite or any steatite of other shades of grey. As it is observed from Appendix A their surfaces had been whitened (possibly by the application of either alkali bleach or a thin talc glaze.



Fig. 8.12: Example of seal from Stage IV/V



Fig. 8.13: Example of seal from Stage IV/V



Fig. 8.14: Example of seals from Stage IV/V



Fig. 8.15: Example of round seal from Stage IV/V



Fig. 8.16: Harappan seals and impressions



Fig. 8.17: Harappan seals and impressions



Fig. 8.18: Harappan seals and impressions

Technologically as well as thematically, there is no difference from any other Harappan site. Almost all seals, bearing a few, are square, with a perforated boss at the back. As elsewhere, the classical seals have beautifully engraved motifs as well as standard boss at the back. However, simple boss, square or rectangular are duly present. Most of the seals bear saw marks on the sides and back. This report covers 225 seals and 60 sealings, which includes a few from the National Museum, and yet to be analysed for want of permission and no access to the materials.



Fig. 8.19: Example of seals from Stage VI



Fig. 8.20: Example of seals from Stage VI



Fig. 8.21: Example of copper seal from Stage VI



Fig. 8.22: Seals of Stage VI and their impressions

During the Stage VI, there is a paradigm change in the typology, ideology and even in material of the seals. These Late Harappan seals are not square, but plano-convex in form. The rectangular face bears the legend with very well cut signs along the longer axis while all the motifs of the previous stages such as animals, composite animals or themes, mythological seals, geometric patterns, or sacred symbols, which may have mostly conveyed the belief system of the people, are conspicuously absent. The convex back of seals is perforated with a hole usually across the thickness. The material of the seals is characterized to be kaolinite as evidenced by

XRD analysis carried out by Randall Law (details in Appendix A). It seems that the supply of the steatite of requisite quality, which was most likely to come from the Indus region by trade, had stopped. The kaolinite is dirty grey in colour. Such plano-convex seals have been reported from Desalpur IB, Surkotada IC and Lothal, all of which are materially coeval.

8.2.1 Analysis of seal findings from Dholavira

The seals, numbering to 225 including those from the ones in display at the National Museum, New Delhi have been subjected to analysis on various factors, like presence of motifs, inscription, locality-wise and period-wise distribution. A total of 130 seals were available for analysis of the nature of motif present on the seals. The analysis indicates that unicorn is the most preferred or the dominant motif including 65 examples, which is inclusive of some doubtful ones. The next category dominating is Bos taurus represented by 6 examples. It is also interesting to note that the exact identification of animal motif in 18 examples (13.2%) could not be made followed by motif missing in again 18 examples. The other prominent motifs noticed among the seal findings are buffalo, elephant, rhinoceros, scorpion, tiger, composite animals, geometric motifs, etc. The count-wise of individual motifs noticed from the seals is given below:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3 headed animal with a human figure	1	.7	.7	.7
	3 headed animal with a plant & a sun motif	1	.7	.7	1.5
	4-dot-in-circles	1	.7	.7	2.2
	7-dot-in-circles	1	.7	.7	2.9
	Animal	18	13.2	13.2	16.2
	Animal & manger	1	.7	.7	16.9
	Animal-composite	1	.7	.7	17.6
	Animal, unicorn probable	1	.7	.7	18.4
	Blurred	1	.7	.7	19.1
	Bos taurus	6	4.4	4.4	23.5
	Buffalo	1	.7	.7	24.3

	Crocodile & fish	1	.7	.7	25.0
	Cross in square	1	.7	.7	25.7
	Dots-in-circles	1	.7	.7	26.5
	Elephant	3	2.2	2.2	28.7
	Geometric	1	.7	.7	29.4
	Goat	3	2.2	2.2	31.6
	Humped bull	1	.7	.7	32.4
	Indeterminate	1	.7	.7	33.1
	Manger	3	2.2	2.2	35.3
	Missing	18	13.2	13.2	48.5
	Mythological scene	2	1.5	1.5	50.0
	Rhinoceros	1	.7	.7	50.7
	Scorpion	1	.7	.7	51.5
	Tiger	1	.7	.7	52.2
	Unicorn	31	22.8	22.8	75.0
	Unicorn ?	4	2.9	2.9	77.9
	Unicorn + manger	28	20.6	20.6	98.5
	Unicorn + manger plus 3 other motifs	1	.7	.7	99.3
	Unicorn probable	1	.7	.7	100.0
	Total	136	100.0	100.0	

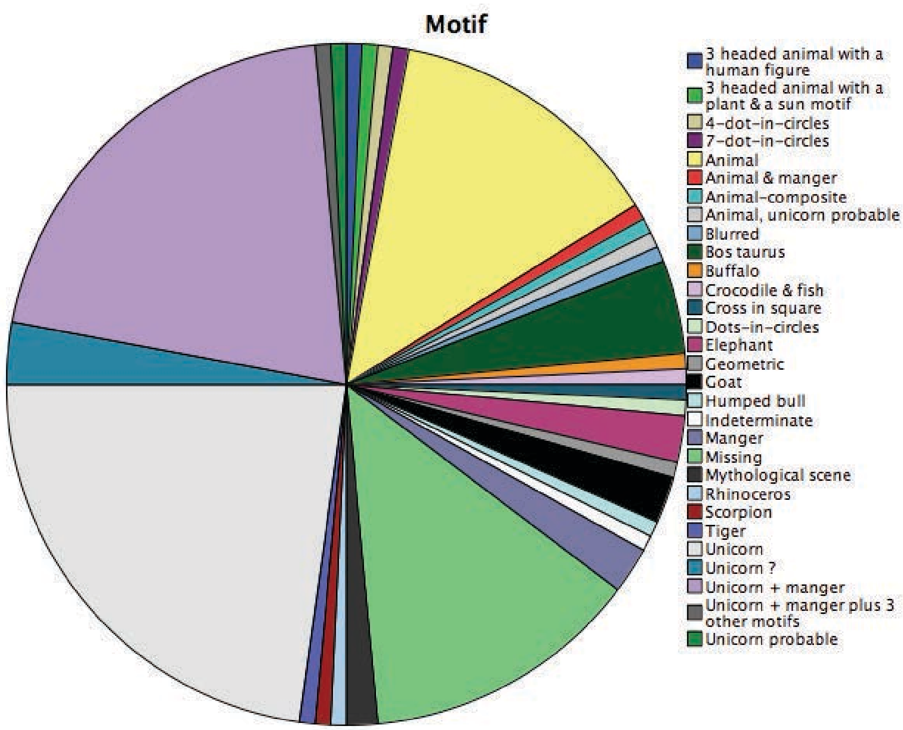


Fig. 8.23: Pie chart showing the percentages of various motifs on seals

The next analysis carried out is on the nature of inscription found on the seals.

A total of 194 seals were available for carrying out the analysis of the presence of inscription. The analysis indicate that out of 194 seals, evidence of inscription was noticed in 139 seals (71.6%) while inscription is missing in 23 examples (23%) and not available in 28 ones (14.4%). The tabulated details of the analysis is given below:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Blurred, if any	1	.5	.5	.5
	Illegible	1	.5	.5	1.0
	Missing	23	11.9	11.9	12.9
	Nil	28	14.4	14.4	27.3
	Not sure	1	.5	.5	27.8
	Probable	1	.5	.5	28.4
	Yes	139	71.6	71.6	100.0
	Total	194	100.0	100.0	

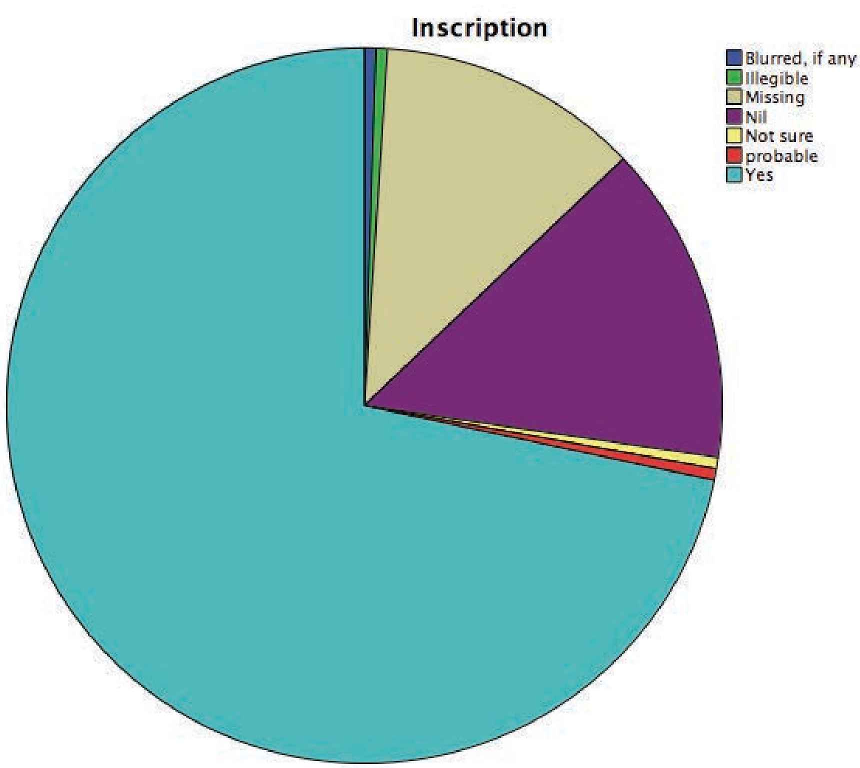


Fig. 8.24: Pie chart showing the percentages of inscribed seals

The pie chart showing the analysis of seals on the presence or non-presence of inscription is given above. The area-wise analysis of the 204 seals was also carried out which indicate that 72 seals are from Middle Town (35.3%), followed by 71 from Castle (34.8%) and 22 from Lower Town (10.8%). Thus, it can be observed that Middle Town and Castle constitute an overwhelming 70.1% of the total seal findings. Bailey is represented by 14 seals (6.9%). If we take into account the administrative character of Bailey and Castle, and the results are clubbed together, they as a single unit dominate the total number of seal findings with 85 seals (41.7%). The analysis indicates the nature of manufacturing and trading control exercised largely by the Castle, Bailey and Middle Town. The following table gives a detailed account of all the seal finds arranged based on their finds from various localities.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Annexe	2	1.0	1.0	1.0
	Bailey	14	6.9	6.9	7.8
	Building at N-W corner of city	1	.5	.5	8.3
	Castle	71	34.8	34.8	43.1
	Castle, south of	1	.5	.5	43.6
	Citadel	1	.5	.5	44.1
	East of castle	1	.5	.5	44.6
	East Reservoir	9	4.4	4.4	49.0
	Great multi-purpose ground	1	.5	.5	49.5
	Lower Town	22	10.8	10.8	60.3
	Middle Town	72	35.3	35.3	95.6
	North ER embankment	1	.5	.5	96.1
	Outside bailey	1	.5	.5	96.6
	Outside castle	2	1.0	1.0	97.5
	Outside Middle Town wall	1	.5	.5	98.0

South Reservoir-3	2	1.0	1.0	99.0
South Reservoir-5	1	.5	.5	99.5
South Reservoir-5	1	.5	.5	100.0
Total	204	100.0	100.0	

The pie chart for the distribution of seals from various localities is given below:

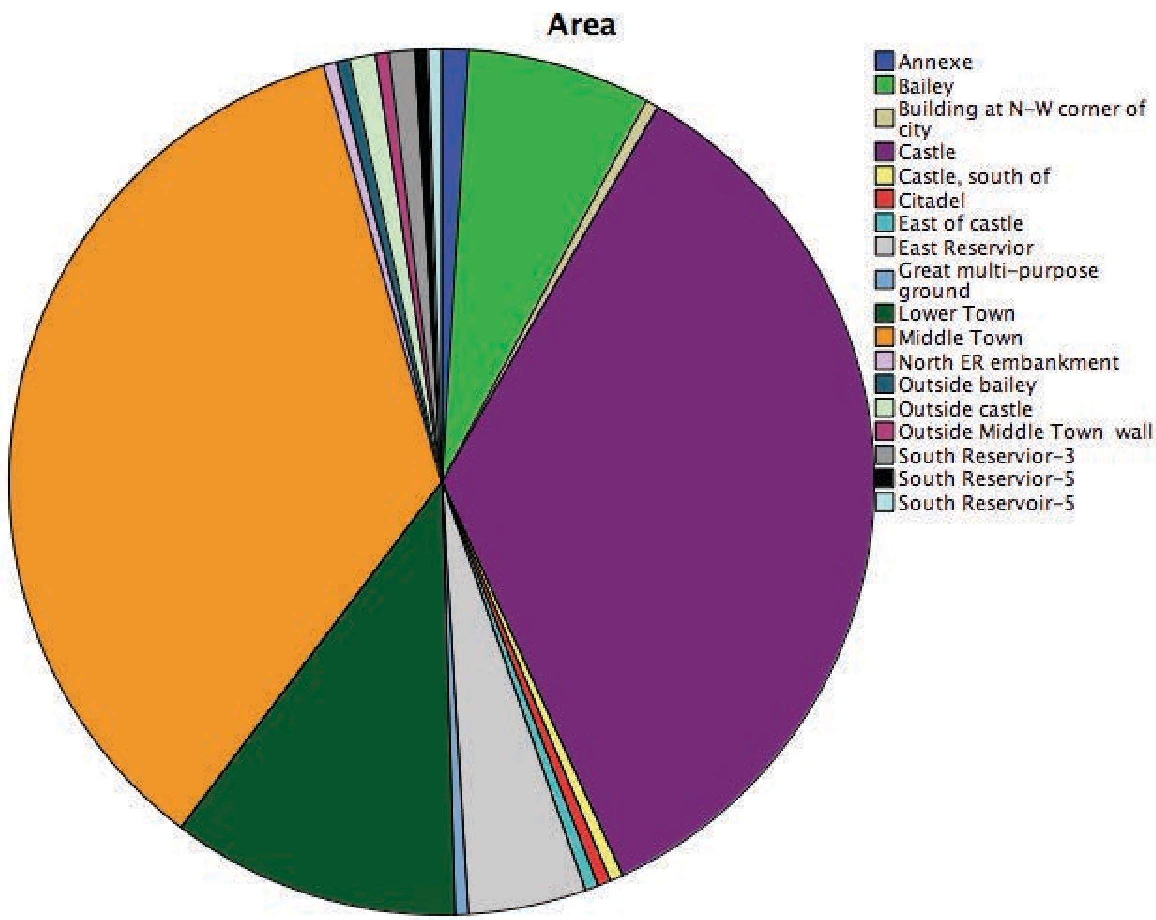


Fig. 8.25: Pie chart showing the percentages of location of seals

The analysis of the seals based on the period in which they were found is available for 185 seals. If we take into account of all the doubtful ones and club it together, the Stage IV and V dominates, which is also not surprising as it represents the mature Harappan phase at the site of Dholavira. These two stages account to a total of 136 seals (73.5%) of the total seals followed by Stage VI, which is represented by 45 seals (24.3%). As indicated elsewhere, the nature of seals during Stage VI changes in a dramatic manner, with the representation of only the

inscriptions. However, the presence of a considerable number of seals from the Stage VI, which is the late Harappan phase at Dholavira clearly indicates the continuation of trade and commerce mechanism, which was peak during the preceding phase, i.e., mature Harappan. The tabulated details and pie-chart of stage-wise representation of seals is given below:

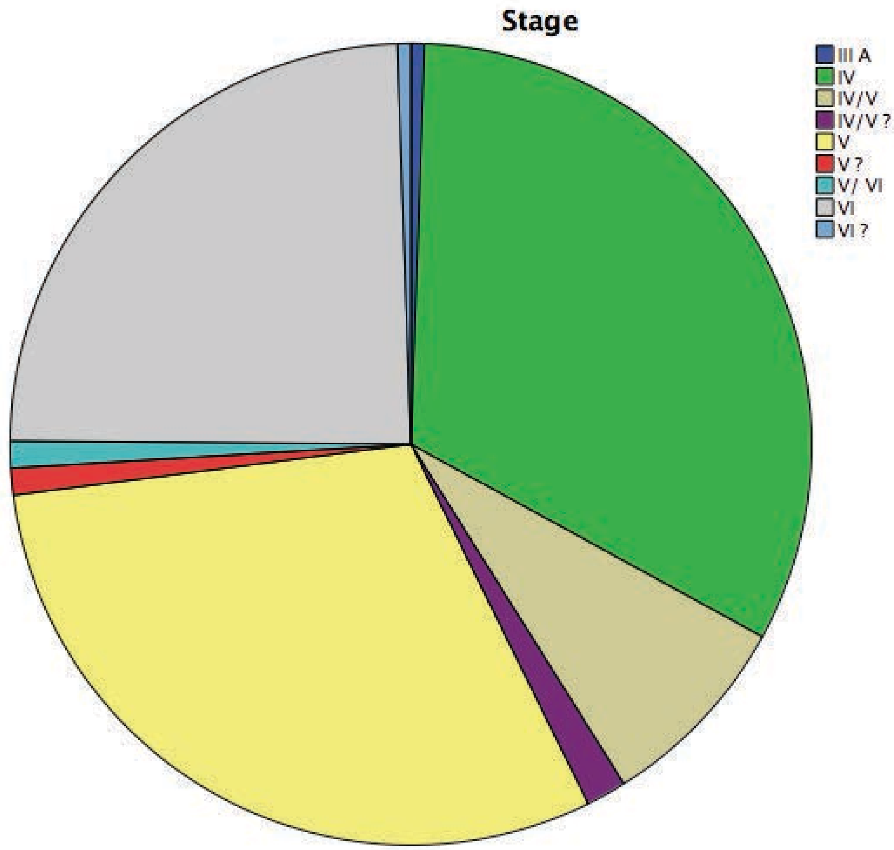


Fig. 8.26: Pie chart showing the percentages of cultural stages of seals

Stage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	III A	1	.5	.5	.5
	IV	60	32.4	32.4	33.0
	IV/V	15	8.1	8.1	41.1
	IV/V ?	3	1.6	1.6	42.7

V	56	30.3	30.3	73.0
V ?	2	1.1	1.1	74.1
V/ VI	2	1.1	1.1	75.1
VI	45	24.3	24.3	99.5
VI ?	1	.5	.5	100.0
Total	185	100.0	100.0	

8.2.2 List of stage-wise seal findings from Dholavira

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
1.	9697 NM	35x14	2	35/14x837x35/15 =297		Unicorn			
2.	14287 NM	45x49x4	Pit sb-1	A.705 cm x D.425 cm		Unicorn			
3.	19050 NM	57x51x1	3	A.264 cm x B.751 cm		Unicorn			
4.	22198 NM	58x51x1	Section cutting	A.325 cm x C.121 cm	-	Unicorn			
5.	23562 NM	54x68x1&2	10	A.530cmxD.995c m	-	Unicorn			
6.	25381 NM	45x59x1	Surface	-		Unicorn			
7.	24795 NM	54x58x1,3&4	4 F	190		Unicorn			
8.	24475 NM	25x10x4	6	A=470cm D=980cm	-	Goat			
9.	16412 NM	55x52	1	A.1297 cm x D.900	-	Animal			
10.	23111	76x4	Surface	-	17.02(ext) x 26.19 X 7.72 - 17.52	Animal	Yes	Outside Middle Town wall	
11.	8498 NM	35x54x1	1	5	-				
12.	9093 NM	M.T.S.W corner of built up area surface finding	-	-			Yes		
13.	9094 NM								
14.	18114 NM	45x42x3	3	32	-				
15.	21897 NM	47x58x1	2	A.110 cm x D.945 cm	-				
16.	25871 NM	47x78x3	Pit2 s.b4	210 to 220	-				
17.	50318	55x89x1	2 Baulk	80					

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
18.	20013 NM	45x58x1	14+15	250					
19.	54388	-	Surface	-	22.85 X 21.71 X 9.12 - Frag	Unicorn + manger	Missing	-	-
20.	33515	48x38x1+2	Bottom of reservoir	-800	15.42 X 15.03 X 4.65 - 8.95	Unicorn + manger	Yes	South Reservoir-5	-
21.	54392	Surface	Surface	-	22.22 X 22.40 X 7.06 - 12.38	Unicorn + manger	Yes	East of castle	-
22.	22023	Surface	Surface	-	-	Unicorn	Missing	-	-
23.	16261	35x63x4+1	1	168	27.98 X 10.29 X 4.84 - 8.79	Nil	Yes	Middle Town	-
24.	2393	XE 22	Surface	-	23.60 X 12.59 X 4.54-8.09	Nil	Yes	Castle	-
25.	19655	47x57x4	7	-175	19.23 X 7.12 X 1.95 - 4.2	Nil	Yes	Castle	-
26.	26435	35x34	-	-	37.80 X 18.37 X 8.97-13.71(ext)	Nil	Nil	-	-
27.	38996	Surface	-	Surface	21.78 x 14.12 X 10.23-Missing	Nil	Yes	Castle	-
28.	5752	83x23x2	2	-60	19.02(ext) X 7.70(ext) X 4.16-Missing	Missing	Missing	Building at N-W corner of city	-
29.	21943	45x84	Surface	-	15.91(ext) X 19.69(ext) X 6.13-Missing	Elephant		Middle Town	-
30.	387	Surface	Surface	-	15.83(ext) X 14.59 X 7.85-Missing	Cross in square	Nil	Middle Town	-
31.	25252	37x74x4	Surface	-	21.04 X 21.0 X 14.38 ext - Missing	Bos taurus	Nil	Outside castle	-
32.	14513	Surface	Surface	-	32.62 X 30.32 X 8.16 - 12.88 knob	7-dot-in-circles	Nil	Lower Town	-
33.	54391	56x55x4	3	A640XD610-160	-	-	-	Middle Town	-
34.	810	XF-22/1	eroded debris	120	24.59(ext) X 9.41 X 3.92 - 7.52	Nil	Yes	Castle	?
35.	23540	24x6x3	2	C 5.15 X D 6.70-8	17.07 X 8.82 X 5.64 - Missing	Nil	Nil	Lower Town	?

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
36.	14225	48x42x1	1	-11	11.01(ext) X 20.24 X 4.82 - 6.28(ext)	Missing	Yes	Castle	?
37.	13204	57x5x2	46	-1142	20.50 X 18.61 X 4.19 - 8.82	Mythological scene	Nil	Castle	III A
38.	33959	45x13x3	4	A966XB579-49	17.38 X 14.80 X 13.37 - Frag	Nil	Yes	Middle Town	Indeterminate
39.	21044	57x57x2	8	307	-	Yes	Yes	Bailey	IV
40.	54387	54x58	Unst.	-	31.29 x 31.65 X 10.38 - 13.44(ext)	Unicorn + manger	Yes	Middle town	IV
41.	5633	48X92X3+4	29C	570	29.32(ext) X 29.33(ext) X 6.11 - 11.29	Unicorn + manger	Yes	Castle	IV
42.	12729	47x21x2	2	-200	24.17X23.86+6.72-11.49	Unicorn + manger	Yes	Castle	IV
43.	16039	56x51x2	3	A655XD858+126	25.19 X 25.43 X 7.65 - 11.72	Unicorn + manger	Yes	Middle Town	IV
44.	20781	57x54x1	8A	230	26.91 X 26.84 X 6.75 - 10.27	Unicorn + manger	Yes	Bailey	IV
45.	21250	57x57x2	10	316	23.63 x 22.60 x 6.74 - 10.33	Unicorn + manger	Yes	Bailey	IV
46.	23497	47x88x4	-	268-275	27.43(ext) X 14.42(ext) X 10.83 - Missing	Unicorn + manger	Missing	Castle	IV
47.	25016	37x35x1	15	-740	-	Unicorn + manger	Yes	East Reservoir	IV
48.	24732	57x57x2	19 to 29	367 to 482	Ext 31.11 X Ext 26.57 X 11.15	Unicorn + manger	Missing	Bailey	IV
49.	8496	46x45x1+2	(2 B)	-220	24.62 X 23.61 X 6.49 - 11.06	Unicorn ?	Yes	Middle Town	IV
50.	19736	57x60x3	2	A1105XB748-143	11.96(ext) X 13.04(ext) X 6.67 -missing	Unicorn	Yes	Bailey	IV
51.	23464	47x88x4	8	-315	14.26(ext) X 21.57(ext) X 11.5 - Missing	Unicorn	Yes	Castle	IV
52.	24731	57x57x2	19-26	367-482	18.03(ext) X 18.73(ext) X 6.44 -8.11(ext)	Unicorn	Yes	Bailey	IV
53.	49820	37x28x2+4	9	-475	24.73 X 25.17 X 5.47 - 12.6	Unicorn	Yes	Lower Town	IV
54.	4341	XF-22/4	24	-	28.62 X 17.93(ext) x	Unicorn	Yes	Castle	IV

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
					6.74 - 8.83				
55.	20306	57x54x1	Pit s.b 6	A.365 cm x B.740-170	25.38 X 25.17 X 4.61 - 13.39	Unicorn	Yes	Bailey	IV
56.	29433	37x55x2+3	16	810	33.48(ext) X 28.26(ext) X 12.25 - 19.93	Unicorn	Missing	East reservoir	IV
57.	39153	48X59	-	-675	33.27 x 33.29 X 7.47 - 13.54	Unicorn	Yes	Annexe	IV
58.	37432	45x63x4	2	63-727X73-550-90	18.28x18.44	Unicorn	Yes	Middle Town	IV
59.	43885	25x83x2	7	A 6.95 X B 10.47-1.63		Unicorn	Yes	Lower Town	IV
60.	11199	25X84X1	4	A518XD880-89	27.37 X 26.90 X 16.12 - 14.44	Rhinoceros	Yes	Lower Town	IV
61.	41434	35x83x1+2	Pit-8 sb 24	4.43		Present but not clear	Not sure	Middle Town	IV
62.	4517	XE 22X1	23	381 to 391	18.17 X 17.91 X 5.04 - 9.07 ext	Nil	Nil	Castle	IV
63.	6747	47x9x2	14	-247	15.46(ext) X 18.43 X 6.75-Missing	Nil	Yes	castle	IV
64.	16305	35x63x1+4	(5) R-1)	-168	18.16 X 16.78 X 3.87 - 5.26	Nil	Yes	Lower Town	IV
65.	17312	47x50x3	6	B775XD260-195	24.24(ext) X 24.05 X 8.57 - 18.25	Nil	Nil	Castle	IV
66.	23106	57x57x2	26	440	35.83(ext) X 24.17(ext) X 10.03 - 19.84	Nil	Yes	Bailey	IV
67.	25460 NM	23x10x1	1	A=3.58mxD=10.07m	-	Nil	Nil	Lower Town	IV
68.	26105	47x78x3	5	-253	17.27(ext) X 10.82(ext) X 4.39 -13.04	Nil	Nil	castle	IV
69.	32457	47x88x3	5	-297	18.45X10.04	Nil	Yes	Castle	IV
70.	54394	XE 22 Q.1	19	294 to 316		Nil	Nil	Castle	IV
71.	6143	48X92X3	32	585 to 600	25.51(ext) X 18.43 X 6.75-Missing	Missing	Yes	Castle	IV
72.	21892	46x44x1	5	A330XD650-170	10.079EXT) X 18.0(ext) X 7.98 - 13.45(ext)	Missing	Yes	Middle Town	IV
73.	23348	25x9x2	2	A 7.62 X B 3.49 - 1.42	23.7 X 17.45(ext) X 6.82 - 9.19(ext)	Missing	Yes	Lower Town	IV

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
74.	23724	54X77X2	2	Ht.65-34	19.52(ext) X 12.01(ext) X 8.18(ext) - Missing	Missing	Yes	Middle Town	IV
75.	48323	47x63x2+3	Pit-4 s.b-25	428	12.94(ext) x 7.97(ext) X 7.76(ext)-Missing	Missing	Missing	Castle	IV
76.	53247	55x95x1	4	55x95-296 55x96-970=130		Missing	Yes	Middle Town	IV
77.	36002	35x63	10	.88-93	16.28(ext) X 9.54(ext) X 10.01 - Missing	Manger	Missing	Middle Town	IV
78.	38885	45x53x2	12	54-455X64-576-249	11.20(ext.) X 14.55(ext.) X 5.88-Missing	Manger	Missing	Middle Town	IV
79.	54284	55x85x3	9	175	-	Indeterminate	Missing	Middle Town	IV
80.	12419	47x12x6	6	-319	14.43 ext +6.97-Missing	Elephant	Missing	Castle	IV
81.	10239	35.53.1	6	A320XB610-140	16.93 X16.54 X 4.39 - 8.78	Bos taurus	Yes	Middle Town	IV
82.	33253	25x7+8	1	-10	28.13 X 28.39 X 9.62 - 13.42(ext)	Bos taurus	Yes	LT	IV
83.	53254	47x84x1	Room no 2 (11)	-325	19.75 X 19.54 X 7.31 - 12.22	Bos taurus	Yes	Castle	IV
84.	5089	48x92x1+2	24	-320	24.59(ext) X 24.51 x 6.04 - 12.02	Blurred	Blurred, if any	Castle	IV
85.	45047	58x8,9	7	A 8.62 X B 9.90 - 3.33	5.41 th	Animal ?	Yes	South Reservoir-5	IV
86.	5091	48x92x1+2	24	305 to 330	19.31(ext) X 7.6- Frag	Animal	Missing	Castle	IV
87.	13350	46x45x1+2	Pit s.b 7	-500	12.44(ext) X 12.57 X 3.13 - 7.37	Animal	Nil	Middle Town	IV
88.	21100	25X73X3	15	-318	27.15 x 3.85-Missing	Animal	Nil	Lower Town	IV
89.	21258	45x43x1	Pit 6 sb-13	-215	15.14(ext) X 10.38(ext) X 6.60(ext) - Missing	Animal	Missing	Middle Town	IV
90.	37021	37x45x4	18	800	26.68 X 28.87 X 8.02	Animal	Yes	East Reservoir	IV
91.	38712	45x53x2	10	64-654X54-225-212	14.94 X ext.14.63 X 5.97 - 10.78	Animal	Yes	Middle Town	IV
92.	18264	55x55x1	3	A440XD570-55	17.48(ext) X 13.60(ext) X 6 - Missing	Animal	Missing	Bailey	IV
93.	45285	47x95x1	10	A 4.40 X B 9.55 -	9.35 th	Animal	Missing	Castle	IV

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
				2.28					
94.	18194	44x44x2	pit-10 sb 10	A 987x B 450-133	15.48 X 11.93(ext) X 2.99 - 5.05	Animal	?	Middle town	IV
95.	42429	35x83x1+2	33	D 6.57 X A 5.86 - 5.58		Animal	Yes	Middle Town	IV
96.	9156	46x45	pit sb-2	320	24.58 x 24.01 x 4.49 - 8.61	3 headed animal with a human figure	Nil	Middle Town	IV
97.	21896	57x5x4	Pit 3 sb 10	-237	-	-	-	Bailey	IV
98.	6383 NM	57x5x4	3	200	1.3 X 1.3 X 0.4			Castle	IV
99.	33526	48x38x1+2	South reservoir -3	835	25.75(ext) X 29.0 X 7.37 - 12.17	Unicorn + manger	Yes	South Reservoir-3	IV / V
100.	51222	38x94x2	2	A668XB365-345	24.51 X 22.49 X 3.87 - 11.17	Nil	Yes	Castle, south of	IV / V
101.	968 NM	XE-23	eroded debris	-	2.6 X 2.6 X 0.8	Unicorn		Castle	IV/ V
102.	13040	37.80.4	3	L1060XB360+85	15.85(ext) X 20.64(ext) X 2.95 - 6.99(ext)	Mythological scene	Missing	Castle	IV/ V
103.	19612	57x28x4	Surface	-	30.03 X 12.01 X 17.64 ht	Crocodile & fish	Yes	Castle	IV/ V
104.	22050	37x49x2	(1 A)	B 2.63 x C 823-0.35 m	17.67(ext) X 15.04(ext) X 6.16-Missing	Unicorn	Yes	East Reservior	IV/ V !
105.	80	Surface	Surface	-	18.11 X 18.02 X 5.96 - 10.26	Unicorn with manger	Yes	Castle	IV/V
106.	32684	37x95x3	Surface	-	21.54 X 21.17 X 7.46-12.51	Unicorn + manger	Yes	Castle	IV/V
107.	50845	37x39x3	8	-360	17.64X17.77	Unicorn + manger	Yes	Eastern Reservior	IV/V
108.	33516	48x38x1+2	Bottom of reservior -1	820	23.28 X 23.10 X 6.32 - 9.21	Unicorn	Yes	South Reservior-3	IV/V
109.	33514	48x38x1+4	Bottom of South reservior -5	-750	16.25(ext) X 14.29 X 4.85 -10.17	Missing	Yes	-	IV/V

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
110.	14224	44x47x3	4	C.291 X D.844 +145	7.57(ext) X 8.28(ext) X 6.57-Missing	Manger	Missing	Middle Town	IV/V
111.	54398	37x55x3	11	SW 350 X NW 790-480	16.96 x 16.68 X 4.05 - 7.92	Goat	Yes	East Reservior	IV/V
112.	22133	35x94x3	Surface	-	22.19 X 14.12(EXT.) X 4.29 - 7.91(ext)	Elephant	Yes	Midle Town	IV/V
113.	43037	37x37x2	6	-205	? X 34.75 X 7.76	Bos taurus	Yes	East Reservior	IV/V
114.	1704	XE 25x1	Debris	125	36.19 X 13.40(ext) X 5.47	Animal-composite ?	Missing	Castle	IV/V
115.	2730	A 19/2		30	13.44 X 12.38 X 3.08 - 6.33	4-dot-in-circles	Nil	Castle	IV/V
116.	11176	47x16	Surface	-	24.11 X 12.15 X 8.82 -	Missing	Yes	Castle	IV/V !
117.	4728	48x72	1	A-860XB-170+18 Room 1-5	20.71 X 21.30(ext) x 4.83 - 8.20 ext	dots-in-circles	Nil	Castle	IV/V ?
118.	52238	47x98x3	-	S.E. 489 to V.W. 266	24x24 X 24.86 X 6.65 - 10.76	Unicorn + manger	Yes	Castle	Unst
119.	42428	47x96x2	3	A 9.51 X D 10.10-1.13	-	Unicorn probable	Missing	Castle	V
120.	21929	45x46x2	-	Unstratified	24.02 x 23.70 X 7.97 - 11.8	Unicorn + manger plus 3 other motifs	Yes	Midle Town	V
121.	10186	25.94.1	3	-40	20.70 X 20.74 X 6.68 - 13.04	Unicorn + manger	Yes	Lower Town	V
122.	10916	55.24.3	2	B738XA796-26	29.97 X 30.38 X 7.02 - 11.85	Unicorn + manger	Yes	Midle Town	V
123.	10922	45x94	Pit sb 2	-71	21.18 X 20.99 X7.09 - 12.89	Unicorn + manger	Yes	Midle Town	V
124.	12829	46x44x1	4	A 320 x B 694 - 80	11.86(ext) X 20.24 X 4.82 - 6.28 ext	Unicorn + manger	Yes	Middle Town	V
125.	14125	44x49x3	3	A1037XB875+44	21.24 X 20.28 X 5.32 - 10.1	Unicorn + manger	Yes	Midle Town	V
126.	15133	55x56x4	2	A 645x D 367X-17	29.42 X 28.78 X 6.38 - 13.94	Unicorn + manger	Yes	Middle Town	V
127.	16566	55x52	1	B765XC450+82	24.87 X 24.89 X 6.01 - 9.8	Unicorn + manger	Yes	Midle Town	V
128.	24820	37x35x1	5	-280	24.21 X 23.85 X 6.04 - 11.37	Unicorn + manger	Yes	East Reservior	V
129.	217	XN 1.4	1A	XN1-	34.26 X 28.84(ext) X	Unicorn + manger	Yes	Midle Town	V

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
				735x2XN1530-20	9.56 - 14.56				
130.	49038	35x12x3	1	284x886-25	28.90X27.19 X7.02 - 11.3	Unicorn + manger	Yes	Lower Town	V
131.	54393	48x1x1	2	-20	23.95 X 23.95 X 7.72 - Missing	Unicorn + manger	Yes	Castle	V
132.	711	A 14/2	1	B 14 2.90X B 15 8.80-0.20	24.83(ext) X 27.26 X 8.31 - 11.77	Unicorn ?	Yes	Castle	V
133.	25916	37x85x1	2	170	31.38 X 11.54(ext) X 7.74 -Missing	Unicorn ?	Yes	Outside castle	V
134.	20131	54x58x2	2	A797xD1153+45	Ext. L22.86 x Ext. 22.67 - 16	Unicorn ?	Yes	Midle Town	V
135.	460 NM	XE-21	Deposit of rain guly	130	2.9 X 2.8 X 0.4	Unicorn	Yes	Castle	V
136.	7503 NM	35x100x2	3	70	1.8 X 1.8 X 0.4	Unicorn		Middle town	V
137.	16622	48x41x1	2	A-456X D-654-85	20.82 X 20.71 X 5.91 - 8.34	Unicorn	Yes	Outside bailey	V
138.	2118	ZA-12:2	1	-8	27.62X (ext) 21.31 X 7.11 - 11.17 ext	Unicorn	Yes	Lower Town	V
139.	8758	35x54x1	2	A500XB620-20	21.07x(ext.) X 20.74(ext.) X 7.57- Missing	Unicorn	Yes,	Lower Town	V
140.	26514	55X66X3	3(in Room)	-25	25.20 X 24.14 X 7.48 - 10.25	Unicorn		Midle Town	V
141.	3693	46x44x1	4	A320XB694-80		Unicorn	probable	Middle Town	V
142.	10616 NM	45x74	4	77		Unicorn		Middle Town	V
143.	35320	47x74x4	4	593x4764-110	20.57 X 11.22(ext) X 6.57 - 9.41	Tigger	Yes	Castle	V
144.	17132	48x42x3	2	-125	26.07(ext) X 20.59(ext) X 8.21 - 15.11	Nil	Nil	Castle	V
145.	12884	38x81x1	1	-100	17.77 X 17.67 X 5.73- Missing	Nil	Nil	Castle	V
146.	18444	57x57x3	2	A1097 B944-85	19.69(ext) X 22.51(ext) X 9.14(ext) -Missing	Nil	Yes	Bailey	V
147.	25412	24x8x2	2	30	51.34 (ext) X 38.06 X 19.88-Missing	Nil	Nil	Middle Town	V

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
148.	33544	55x34x1+4	1 to 3	87	10.35 X 8.74 X 2.12 - 4.74 ht.	Nil	Yes	Middle Town	V
149.	39031	45.13	Unst.	Unst.	23.24(ext) X 24.62(ext) X 7.04-Missing	Nil	Yes	Midle Town	V
150.	6226	47x7x3	1	-60		Nil	Nil	Castle	V
151.	218	XN 1/4	1A	XN 1.7.25x2 XN1. 5.25= 0.2	24.63(ext)X14.63(ext) X 9.86- Missing	Missing	Yes	Middle Town	V
152.	9824	45x54x1	3	-56	64.0EXT) X 19.69EXT) X 23.44-Missing	Missing	Yes	Middle town	V
153.	27511	55x14	Surface	Surface	Fragment	Missing	Yes	Midle Town	V
154.	34881	35x73x4	3	-48	16.75(ext) X 16.37(ext) X 6.53 - 10.56	Missing	Yes	Midle Town	V
155.	16863	47x50x3	4	A 11.10 X D 8.40 X 1.50		Missing	Yes	Castle	V
156.	19577	57x60x3	2	-99	ext 30 x 20 X 5- 7	Missing	Missing	Bailey	V
157.	54395	25x2x4	2	A 7.30 X D 4.55 - 43	19 x 7.5 X 5 m	Missing	Missing	Lower Town	V
158.	48567	35x73x3+4	1	-79	25.55 X 25.28 X 6.24 - 11	Humped bull	Yes	Middle Town	V
159.	40792	25x93x1	2	A 2.23 X -0.40	15.90 x 15.40 X 3.52 - 7.49	Goat	Nil	Lower Town	V
160.	33247	67x83x2	2	A765XB460-75	24.78 X 23.46 X 6.49 - 11.06	Buffalo	Nil	Bailey	V
161.	50395	35x13x4	1	D 1.70xc 8.40-0.30	21.27 dia.X 6.27 - 7.70 (ext)	Bos taurus	Yes	Lower Town	V
162.	54399	46x62x2	2	-105	29.49 X 27.56 X 8.34 - 14.28	Animal, unicorn probable	Yes	Midle Town	V
163.	19943	45.33.3	5	A1170XD1075-55	26.73(ext) X 28.01 X 9.33 -13.97	Animal (most probably unicorn)	Yes	Midle Town	V
164.	18569	58x52x1	4	3 DR: A 3.85 x B 8.53 - 0.73	29.56 X 12.06(ext) X 7.03 - 9.38(ext)	Animal & manger	Missing	Bailey	V
165.	22100	25x1x3	2	A=10 m X D=6.50-51	24.31 x 12.39(ext) X 7.89 - 9.91(ext)	Animal	Yes	Lower Town	V
166.	22469	24x7x3	1	C426XD854+20	14.15(ext) X 15.02 X 4.6-Missing	Animal	Yes	Lower Town	V
167.	31655	66x57x1	2	550X523-100	30.21(ext) X 23.36(ext) X 8.95-Missing	Animal	Yes,	Great multi-purpose ground	V

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
168.	34894	46x23x4	2	965x415-21	20.67 X 20.02 X 5.81 - 12.56	Animal	Yes	Midle Town	V
169.	40791	55x76x2	2	A 95 X B 20 =0.28	29.29 x 29.15 X 6.57 - 12.67	Animal	Yes	Middle Town	V
170.	10057	35x04	3	04:366x94:697-0.47	19.74 X 19.61 X 3.94 - 8.06 Knob	3 headed animal with a plant & a sun motif	Nil	Lower Town	V
171.	26382	25x94x1	Surface	-	30.18 X 30.32 X 7.98-12.19(ext)	?	?	Lower Town	V
172.	18034	57x34x4	-	1.25	Small Fragement	-	-	Castle	V
173.	18113 NM	45x42x2	2	62	23.27 X 22.79 X 5.78 - 10.06 Knob	-	-	Middle Town	V
174.	9954	45X34X3	2	-25	32.04 X 20.60 X 7.99-Missing			Middle Town	V
175.	10024	46.45	Great Pit sb 2	45-1050X55-155-240	20.07 X 14.04(ext) X 5.02 - 5.93	Scorpion	Missing	Midle Town	V !
176.	13602	45.40.2	Surface	-	35.50X(ext.) X 27.19(ext.) X 12.45 - 20.25	Unicorn	Yes	Midle Town	V ?
177.	43486	55x77x4	2	A 7.5 X D 3.1 - 0.70		Nil	Yes	Middle Town	V/ VI
178.	51582	55x86x4	3rd	55x96-270-43 55x97-880-43	18.12 X 7.09 -5.64 at apex	Nil	Yes	Middle	V/ VI
179.	1971	ZA 1/1	1	A1-560XZA1-455-73	24.14(ext)X23.0 X17.89- Missing	Nil	Yes	Middle Town	VI
180.	2283	ZA-11x1	3	-27	23.84 ext x 15.53-Missing	Nil	Yes	Middle Town	VI
181.	4579 NM	A 17/4	pit D sb-16 N	33	1.3 X 2.8 x 8	Nil	Yes	Castle	VI
182.	7875	47x10x2	2	15	19.39(ext) X 21.23 X 12.83-Missing	Nil	Yes	Castle	VI
183.	8198	47X47X4	4	(+)550 To -570	27.18 X 15.14 X 10.95-Missing	Nil	Yes	Castle	VI
184.	9543	46x44x2	5	-190	22.45 X 11.78 X 3.2 - 11.7	Nil	Yes	Midle Town	VI
185.	10342	46x43	3	43.920x44:4:15-1.75	18.74 X 11.36 X 7.41 ht	Nil	Yes	Middle Town	VI

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
186.	11866	46x42	5	A820XD240-224	11.30(ext) X 7.94 X 5.26 - 5.82	Nil	Yes	Midle Town	VI
187.	13039	47.46.1	2	-70	16.72(ext) X 10.47 X 2.72 - 6.01	Nil	Yes	Castle	VI
188.	13046	45x4x2	3	A598XD1120-102	23.11(ext) X 14.80 X 6.97 - 13.38(ext)	Nil	Yes	Midle Town	VI
189.	15496	56x54x1	2C	A 530XD 675-82	14.46(ext.) X 8.27(ext.) X 2.59 - 5.14(ext.)	Nil	Yes	Midle Town	VI
190.	15726	35x53x4+1	Pit1 sb-1	-80	31.88 x 14.45 X 6.4 - 11.15	Nil	Nil	Midle Town	VI
191.	16262	35x63x1+4	Pit 1 sb 5	165	13.84(ext) X 29.33(ext) X 4.23-Missing	Nil	Yes	Midle Town	VI
192.	17376	58x11x3	5	(-) 84 to -94	32.20(ext.) X 19.50 X 14.56-Missing	Nil	Yes	Castle	VI
193.	18036	65x64x1	2	-40	15.76(ext) X 8.80(ext) X 9.8 -Missing	Nil	Yes	Midle Town	VI
194.	18204	58x11x3	3	A924XB528-26	21.78(ext) X 16.82(ext) X 13.13 - 11.37	Nil	Yes	Castle	VI
195.	21893	47X34X4	2	50-60	15.37 X 10.12 X 5.71	Nil	Yes	Castle	VI
196.	21894	65X54X4	2	A730XD560-40	20.52(ext) X 12.99 X 11.8 - Missing	Nil	Yes	Midle Town	VI
197.	21895	47X68X4	1	A900XD245-45	15.99(ext) X 9.73 X 6.62-Missing	Nil	Yes	Castle	VI
198.	26119 NM	58x19x4	2	455	-	Nil	Yes	Annexe	VI
199.	27192	47x89x2	5	.95-119	10.35(ext) X 9.32 X 3.13 - 6.82(ext)	Nil	Yes	Castle	VI
200.	31420	47x67	3	50-105	21.10 X 11.43 X 2.85 - 5.87, curved back	Nil	Yes	Castle	VI
201.	32533	48x91x3	1	-15	13.16(ext.) X 12.18(ext.) X 14.18 - Wagon-vault	Nil	Yes	Castle	VI
202.	34492	45x13x1	2	A300XD821-26	9.09(ext) X 11.77 X 8.07-Missing	Nil	Yes	Midle Town	VI
203.	34566	47x64x4	2	728x480-32	27.90 X 27.27 X 4.61 - 10.53	Nil	Nil	Castle	VI
204.	39152	35x73x1	2	26	20.62(ext) X 16.40 X 12.83 -Missing	Nil	Yes	Midle Town	VI

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
205.	39158	47x76x4	3	-75	26.93 X 16.21 X 2.54 - 13.39	Nil	Illegible	Castle	VI
206.	33692	35x63x4	2, distrubed	63x3-604X634-675+11	27.27 X 11.95 X 3.51-8.24	Nil	Yes	Middle Town	VI
207.	33693	35x63x4	2	-6	28.14(ext) X 17.39 X 12.69-Missing	Nil	Yes	Lower Town	VI
208.	24138	37x34x4	6	Ht 19	-	Nil	Yes	North ER embankment	VI
209.	49150	47x33x2	4	-94	15.66(ext) X 8.74 X 2.59 - 6.34	Nil	Yes	Castle	VI
210.	48931	47x66x4	-	680X321-44	24.83(ext) X 12.54 X 3.61 - 10.8	Nil	Yes	Castle	VI
211.	49846	47x83x2	Room No. 2 &3	D870 XA127-131	21.31 x 11.14 X 0.99 - 7.21	Nil	Yes	Citadel	VI
212.	39439	37x56x3	12	380		Nil	Yes	East Reservior	VI
213.	40471	47x73x2	14	A 740X D 102-2.20	15.5-16.6	Nil	Yes	Castle	VI
214.	41036	47x56	1	A 6.75 X B 5.31-39	22.18 x 10.68 X 2.94 - 7.52	Nil	Yes	Castle	VI
215.	41836	47x63x3	8	A 7.73 x D 11.40-0.70	-	Nil	Yes	Castle	VI
216.	43421	47x95x1	2	A 3.65 X B 9.20-0.70		Nil	Nil	Castle	VI
217.	44145	55x77	2	A. 7.10X D 7.15 -0.30		Nil	Yes	Middle Town	VI
218.	19787	47x46+47x48	3	185 to 240		Nil	Yes	Castle	VI
219.	47242	47x85x4	6	75 to 78	-	Nil	Yes	Castle	VI
220.	52359	47x98x4	-	110 to 200	9.42	Nil	Nil	Castle	VI
221.	54390	57x9x2	2	-70	26.86 dia circular	Geometric	Nil	Castle	VI
222.	17758	55x52	2	B816xC505+65	11.62 X 6.78 X 3.09 - 6.43	?	?	Midle Town	VI
223.	3958 NM	A/17	Pit sb 12	260-320	9 X 1.8 X 0.6			Castle	VI
224.	33542	47x97x3	Filling	5	32.52 X 14.85 X 4.91 - 16.28 ht.	Nil	Yes	Castle	VI !
225.	26818	47x79x3+4	3	70 to -80	26.42 X 8.45(ext) X	Missing	Yes	Castle	VI- ?

Sl. No.	Acc No.	GSQ	Stratum	Depth/3DR in cm	Size: LxWxTh, Th-knob in MM	Motif	Inscription	Area	Stage
					7.14 - 8.88(ext)				Mispla ced

8.2.3 Details of individual seals from Dholavira

Sl. No.	Acc. No.	Remarks	
1.	80	Unicorn, standing to L, wrinkled neck *pipal* leaf spread on withers; to tiered manger. Inscription 3 signs. Knob: round, grooved, perforated, partly missing. A classical made-to-order type with upper L corner partly missing	
2.	218	Only upper right part with 4 signs of inscription; the rest missing	
3.	387	A very unusually, a fragment of plano-convex seal seems to have been modified into a piece that bears a cross in square motif; the object shows one depression each on two sides of a corner.	
4.	460	In. Nat.mus	

Sl. No.	Acc. No.	Remarks	
5.	711	L part much damaged, Animal most probably unicorn with wrinkled neck, standing to L, head, horn, part of body, four legs missing. Inscription is 5 signs intact one partially extant	
6.	810	Inscription is of 2 signs complete one partly perforation in curved back	
7.	968	In Nat.Mus	
8.	1704	Approx. 1/3 of a seal showing. Extant part shows lower head of a bull on left and three legs and tails of a tiger in the central and R part the remaining missing. Knob: in traces	
9.	1971	R half of a large seal, broken at apex R half. Inscription: present but defaced in upper register, while much area down below have no details	

Sl. No.	Acc. No.	Remarks	
10.	2118	Unicorn standing to L, leg part missing lower part of manger missing Inscription 5 signs. Knob: round grooved and perforated, but much knocked off made-2-order classical seal	
11.	2283	Left part extant, inscription of 3 signs present, one of which partly missing back is wagon vault a trace of red colour on the apex	
12.	2393	A rare type of plano-convex seal with a round grooved knob with perforation on the back. Inscription. 4 signs	
13.	2730	A button seal with four dots in circles, arranged is corner. dot in two concentric circles Non-classic perforated boss it might came from stage VI, perhaps, a case of mix-up.	
14.	3958	In Nat.Mus	
15.	4341	Unicorn, only in traces, horn a year partly withers; standing to LEFT lower half considerably missing. Inscription 7 signs	

Sl. No.	Acc. No.	Remarks	
16.	4517	Clouded grey steatite seal blank; knob split open & much worn. Possibly indented to be recarved but effort given up	
17.	4579	Inscription. 4 signs, In Nat.Mus	
18.	4728	One side and one corner, damaged 7-dots-circles fully or partially preserved	
19.	5089	All details blurred but fore some traces of symbols one corner missing. Knob square, unperforated	
20.	5091	Animal, standing to L, but front part missing upper body partly missing. Knob: missing, Inscription: missing	

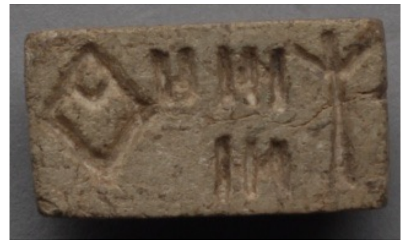
Sl. No.	Acc. No.	Remarks	
21.	5633	Very much weathered and fragile, Unicorn, standing to L, other details, including that of manger are blurred lower R & L corners are missing or damaged Inscription about 6 signs. Knob: round, grooved, perforated Classical, made-to-order type	
22.	5752	A splitter of all white steatite seal, quite fragile, 3 strokes visible- 2 slanting somewhat parallel, the third one	
23.	6143	Only central part with a smaller field with 1 sign, partially missing. One half of knob extant	
24.	6383	In Nat.Mus	
25.	6747	Inscription: 1 sign complete, appears to be kaolinite	
26.	7503	Unicorn Standing. to left Inscription: 3 signs. In Nat.mus	

Sl. No.	Acc. No.	Remarks	
27.	7875	Inscription: 3 signs. R half and perforation missing	
28.	8198	Inscription: 2 signs	
29.	8496	Most likely, unicorn, standing to left, head missing; Y-shaped sign in place of manger Inscription 2 signs heavily patinated	
30.	8498	In Nat.Mus	

Sl. No.	Acc. No.	Remarks	
31.	8758	Badly exploding unicorn standing. to L, no other details. Knob missing. All white steatite.	
32.	9093	In Nat.Mus	
33.	9094	In Nat.Mus	
34.	9156	3-headed animal Standing to R, with a human figure: lower head of *Bos taurus* middle one of unicorn and third one of possible of mountain goat, and a human figure in upper right corner. All white steatite with a lightly glazed surface. Knob curved as wagon vault with vertical perforation. Saw marks clearly visible on the back.	

Sl. No.	Acc. No.	Remarks	
35.	9543	Inscription: 3 signs partly preserved	
36.	9697	In Nat.Mus	
37.	9824	A piece of a large object having 2 finished faces partially preserved. Inscription: one face bears nicely cut 4 signs; down below there seems to be a secondary work involving shallow & careless engraving of a wheel attached with a horizontal bar (not completely present) with an oval sign cut just above the bar; second side also bears and Inscription but only in faint traces Khaki steatite, below which there is cut a deep groove. it seems at some point it was used for experimentation	
38.	9954	Broken and cracked. Does not need any intervention. Manger on the left, below the head of unicorn! Visible head of unicorn is also vaguely visible, so far the two front legs and one hoof left one. Others not available nor the inscription, if ever.	

Sl. No.	Acc. No.	Remarks	
39.	10024	Less than 1/2 showing only scorpion no other details. Knob missing.	
40.	10057	3 headed animal standing to R, with a plant in the upper central part: one, *Bos taurus* with lowered head; central one of unicorn third one with horns curved forwardly; a sun motif in between the first two heads. Knob Wagon-vaulted, perforated horizontally	
41.	10186	Unicorn standing to L, wrinkled neck, *pipal* leaf spread visible. 1-tiered manger. Inscription 3 signs. Knob: round, grooved, perforated all white small seal, classical made-to-order type.	
42.	10239	All white steatite, upper R corner missing 2-horned hump less bull (Bos tarurus) standing to L, possibly with a trough placed below Inscription: only 1 sign ext. Knob: ordinary with perforation	

Sl. No.	Acc. No.	Remarks	
43.	10342	Inscription: 3 signs, wagon-vault back with horizontal perforation	
44.	10916	Upper L corner missing so is a part of upper right part. Inscription: 4 or 5 signs visible. knob round, grooved, perforated. All white steatite. Classical made-to-order type	
45.	10922	unicorn standing to L, possibly with a garland round neck; 2 tired manger place below the head buff steatite coated white all over, including the sides and the back, glazed visible on the raised part of the front side. Standard, round, grooved knob with perforation inscription 2 signs	
46.	11176	A small upper L, part. Inscription 3 sings complete, 4th partly the rest missing	

Sl. No.	Acc. No.	Remarks	
47.	11199	Rhinoceros, standing. to L, with feeding trough placed below. under head. Inscription: well cut & balanced in upper part, but not clearly visible heavy encrustation. standard knob: grooved, perforation. Upper right corner missing. Classical made-to-order type. crack obliquely very fragile	
48.	11866	Broken half at perforation. Inscription 2 signs carelessly engraved-difficult to describe	
49.	12419	Less than 1/4 of seal, lower left elephant standing to L only represented by 2 tusks, wrinkled trunk & 1 front an ear. Knob in trace	
50.	12729	Unicorn standing to left, *pipal* leaf décor on shoulders; manger. Inscription: 2 sign. Knob: round, grooved, perforated. All white, classical made-to-order seal.	

Sl. No.	Acc. No.	Remarks	
51.	12829	1/3; part ext. Unicorn, standing unusually to R, horn & head wrinkled neck one foreleg ext. manger a different kind. Inscription 1-sign partially exterior, Knob: largely missing light grey steatite. With traces of coating	
52.	12884	Black steatite. Seal blank A circular 5.5 mm bored depression in the centre on the backside in place of the knob Saw marks all over.	
53.	13039	Status: upper L missing. Inscription: 2 signs, cut deep neatly.	
54.	13040	1/3 piece a frag Man walking to L, perhaps holding a weapon in his raised L hand, R hand stretched outturned at elbow. Other details missing, seems to be a combat scene. Knob square, perforated partially damaged	

Sl. No.	Acc. No.	Remarks	
55.	13046	Broken half at perforation. Inscription 3 sign. Curved back with perforation	
56.	13204	# VIVO imp. Early Stage III A. A horned deity, standing erect, between two branches of a tree, each with 3 leaves on outer side and one at the top of a devotee kneeling with bent R leg and L being drawn at the knee & the hands touching the ground before the deity, R lower side a goat, with outstretched wavy horns, upturned tail, standing facing the deity. Knob: Wagon-vault, with a vertical perforation. Saw marks visible on the back.	
57.	13350	A tiny seal, Animal, standing, unusually to R, 2 outspread horns, animal looking backwards to L, wrinkled neck; three legs intact, 4^{th} R missing. Smooth finish – saw marks visible Lower left corner missing. No Inscription, Vaulted knobs with perforation.	
58.	13602	Unicorn standing. to L, only horn, head, neck & upper body partially preserved, perhaps *pipal*-leaf spread indicated. Inscription 1-sign complete the other partially ext. Knob: round, grooved, perforated, partly missing. Grey steatite lightly coated with white. it is a part of a large seal.	

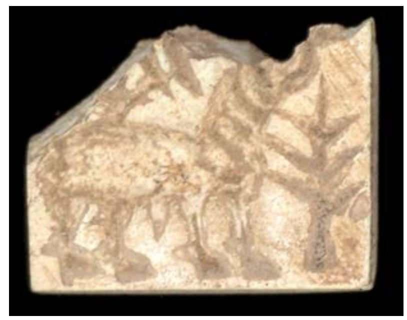
Sl. No.	Acc. No.	Remarks	
59.	14125	Unicorn standing. to L, shoulder decoration not clear, though possible. 2-tiered manger. Inscription 3 signs. Knob: round, grooved, perforated. White coated all over. Classical made-to-order type.	
60.	14224	Very tiny lower L corner of a small seal showing only 2-tiered manger, the rest missing, grey steatite.	
61.	14225	A tiny top R part of a seal, possibly square. Only some vertical strokes in 3 row frank on R by long vertical stroke, one more is very partially visible; Knob is missing Khaki steatite coated white.	
62.	14287	In Nat.Mus	

Sl. No.	Acc. No.	Remarks	
63.	14513	7 dot-in circles: each has 2 concentric rings with dot in the centre--3 each in upper and lower rows. & 7th on L between the rows Knob Flattish and perforated boss.	
64.	15133	Manger 2-tiered Inscription: 5 signs badly much damaged. Knob: round, grooved, perforated.	
65.	15496	Small R half of seal Broken at perforation. Inscription: 3 signs extant, Khaki steatite coated white	
66.	15726	No details no perforation	
67.	16039	Unicorn standing to L, wrinkled neck spread on withers: 2 tiered manger Inscription: 5 signs. Knob: round, grooved, perforated. All white, coated and glazed. A long crack, nearly, horizontal present.	

Sl. No.	Acc. No.	Remarks	
68.	16261	Inscription: 5 signs field in with patina. L upper corner missing so is part of 1 sign. All white steatite. Most Importantly: Copper wire is present in the perforation.	
69.	16262	L half. Broken at perforation. Inscription 3 signs intact, 4th partially present. It a tiny well made, well engraved seal of all white steatite	
70.	16305	An unfinished, buff steatite, tiny seal with 1 sign. Upper R corner missing. Knob: area rubbed off.	
71.	16412	In Nat.Mus	
72.	16566	Much of the obverse is flaked off. Much. However, unicorn standing to L with manger in the front. Inscription: only 1 sign intact on the LEFT Knob: round, grooved, perforated, partly missing. All white, classical.	

Sl. No.	Acc. No.	Remarks	
73.	16622	Unicorn, standing to L, wrinkled neck pipal leaf spread on withers; manger to tiered. Inscription: 5 signs. Knob: round, grooved, perforated. Classical, made-to-order.	
74.	17132	A fragment of unfinished seal, with square knob, unperforated.	
75.	17312	Broken half as well as 1 corner missing. Details seem to have been erased. Knob ordinary square with perforation.	
76.	17376	Inscription 3/4 signs visible the rest missing. Only L half along with some L part missing it a large plano-convex seal	

Sl. No.	Acc. No.	Remarks	
77.	17758	Lower L frag, showing perhaps half of cross-in square motif. Upper and L part along with perforation missing	
78.	18034	Exploded	
79.	18036	Inscription: 2 signs incomplete. Back wagon vaulted lower L missing no perforation area despoiled by late Harappans	
80.	18113	In Nat.Mus	

Sl. No.	Acc. No.	Remarks	
81.	18114	In Nat.Mus	
82.	18194	Standing unusually to R there is was tree placed below its head, animal muzzle & horn (s) missing wrinkled neck; a tree with 6 branches & top placed in front under the head. Inscription: some lines are present but difficult to figure out; Knob: wagon vaulted with perforation. Very tiny seal of white steatite	
83.	18204	Small part. Inscription 2 signs.	
84.	18444	Small frag all white steatite seal, 2 fragile, fissured & broken to describe. however, Inscription: 3 signs partially preserved. Faint outline suggest possibly of an animal	
85.	18569	Animal, standing to L, 4 legs & tail preserved along with lower part of manger. The rest missing Knob: round & grooved partially visible all white steatite. Seems to be classical made-to-order	

Sl. No.	Acc. No.	Remarks	
86.	19050	In Nat.Mus	
87.	19612	Inscription.: 4- signs, 5th possible on rectangular face. A crocodile, with 4 legs, a tail, bulging eyes, blurred snout, & with some in distinct symbols on curved back. Found in west gate complex.	
88.	19655	Well-cut with smooth finish & straight perforation. Inscription 4 signs	
89.	19736	Small frag, L upper corner part. Unicorn represented by horn, an ear & tiny part of head Inscription: 1 complete & one part of sign ext. Knob missing. Buff steatite, coated white. Classical made-to-order type.	

Sl. No.	Acc. No.	Remarks	
90.	19943	Animal (most probably unicorn), standing to L since the seal is extremely shattered & L side missing partly, no further details visible. Knob: round, grooved, perforated and partly missing.	
91.	20306	Unicorn, standing to L, wrinkled neck; manger 2-tiered. Inscription: 5 signs in two rows.	
92.	20781	Unicorn, standing to L, pipal leaf symbol on the withers. Only upper half manger preserved as lower left corner is missing Inscription. 8 signs in upper margins-6 in one row and two below on the R. Knob round grooved and perforated horizontally. All white steatite.	
93.	21044	Small central part. Inscription: only 1 sign partially extant, the rest missing small part. Knob: round, grooved present with perforation visible	

Sl. No.	Acc. No.	Remarks	
94.	21100	Small lower part of seal showing perhaps *Bos taurus* with lowered head all other details missing	
95.	21250	Unicorn standing. to L, *pipal* leaf spread withers; manger 2 tiered Knob: round, grooved, perforated, Inscription 5 signs; classical made-to-order type.	
96.	21258	Only small lower R corner ext. only hind legs & partly lower body visible back part is also flaked off.	
97.	21892	Only upper central part preserved. Inscription: 2 rows of signs: upper row has 2 complete & 3rd slightly visible; in lower row 3 signs, partly preserved	
98.	21893	A tiny buff steatite. Inscription: 3 signs	

Sl. No.	Acc. No.	Remarks	
99.	21894	Broken at perforation; Inscription 3 signs	
100.	21895	L half, broken at perforation. Inscription: 2 complete signs 1 partially extant	
101.	21896	Exploded into pieces	
102.	21897	In Nat.Mus	
103.	21929	Most unique seal Obverse: unicorn, standing to L, with garland round the neck & spread on the back; 2- tiered manger. Inscription: 3 signs Reverse: 3 separate motifs: bull man, horned bull, fish eating *gharial*, all engraved around the knob-round, grooved, perforated. all white steatite seal, partly broken at lower R corner. classical made-to-order type.	

Sl. No.	Acc. No.	Remarks	
104.	21943	Small lower L corner only. Elephant standing to L, only 2 tusks, ringed trunk & 1 fore leg ext. Knob: missing. All white, coated and glazed	
105.	22023	Unicorn Standing. to L, lower body missing, manger missing Knob much damaged. Perhaps, unfinished	
106.	22050	Only upper R corner ext. unicorn, recognizable by its horn, part of head & some upper margin of body, the rest missing. Inscription: 4 signs ext. Knob: missing; grey steatite coated white, as seen it traces.	
107.	22100	Only 1/3 upper part of seal, Animal- only upper contour line faintly visible. Inscription: 4 signs; Knob missing although slight trace present	
108.	22133	Upper half of seal, Elephant, unusually standing to R, lower body including trunk legs missing. Inscription: 1 sign at upper L corner intact. Knob: missing. Grey steatite with traces of white coating.	

Sl. No.	Acc. No.	Remarks	
109.	22198	In Nat.Mus	
110.	22469	Tiny seal much damaged. Animal standing to L, Inscription : 3 signs; L one partially damaged all white tiny steatite seal, L margin missing much of the back part including knocked missing appears to be classical, made-to-order type	
111.	23106	Only some central part ext. Inscription: 2 large-sized signs ext. Grey and brown layers very unusual seal, Knob: largely missing but two sides making up R corner without any perforation seems to be an apprentices.	
112.	23111	Animal, standing to L, neck, head, 1 four leg one hind leg, partly tail missing. Inscription: 1 sign complete 2 very partially visible. Knob: round, grooved, perforated, partly missing. Grey steatite, white coating visible. Classical made-to-order type.	

Sl. No.	Acc. No.	Remarks	
113.	23348	2/3 of a seal; Field almost knocked off only 2 signs are partially extant, Knob: round, grooved, perforated; light grey steatite, white coated.	
114.	23464	Unicorn standing to L, only horn, an ear and part of head ext in a small upper L corner. Inscription: 3 signs complete, 4th in trace. All white, glazed all over. Uniquely, 1.8 mm groove is cut in the thickness of seal, on upper as well as L side. Cutting is meticulous and straight seems to be an after though. Classical, made-to-order type.	
115.	23497	Only muzzle and two-tiered manger present on lower left part while the completely missing	
116.	23540	A blank without perforation	
117.	23562	In Nat.mus	

Sl. No.	Acc. No.	Remarks	
118.	23724	A small seal is splinter. Inscription: 2 signs one of which partially ext	
119.	24475	In Nat.Mus	
120.	24731	Only upper R corner preserved Unicorn (only recognizable by partially preserved pipal leaf spread on withers) standing. to L, Inscription 2 signs & one or two in traces Knob is missing. All white appears to be classical.	
121.	24820	Unicorn, standing. to L; wrinkled neck spread on back, 2-tiered manger. Inscription 8 signs. Knob: round, grooved, perforated. Classical, made-to-order type. Grey steatite coated white much worn. Bears multiple cracks.	

Sl. No.	Acc. No.	Remarks	
122.	25016	Unicorn standing to L, 2 tiered manger wrinkled neck. Inscription 7 or more signs. Knob no trace visible. Execution is fine and balanced.	
123.	25412	Grey and white steatite piece on baked	
124.	25252	Bos taurus standing to LEFT No further details exception a bored hole near as on top black steatite	
125.	25381	In Nat.Mus	
126.	25460	In Nat.Mus	

Sl. No.	Acc. No.	Remarks	
127.	25871	In Nat. Mus	
128.	25916	Only R upper part ext. horn of unicorn present, the rest missing. Inscription: 3 signs partially ext. Knob: missing. All white seems to be classical made-to-order type	
129.	26105	Badly fragmented. Animal (possibly unicorn in traces) standing to left Inscription: 3 signs complete 1 or 2 in traces. Knob: grooved, round, perforated. It is all white tiny seal Classical, made-to-order type	
130.	26119	Inscription: 3 full signs & one half signs (2 strokes). In Nat.Mus	
131.	26382	Badly weathered. No details recognizable, though faint traces visible some pieces have fall an out	
132.	26435	Seal blank, clouded grey steatite knob largely missing with top been knocked off.	

Sl. No.	Acc. No.	Remarks	
133.	26514	Unicorn standing to L, muzzle missing wrinkled neck; manger 2 tiered, partly missing. Inscription: 6 signs; Knob: round, grooved, perforated. White & grey steatite, white coated. Very fragile a part of back separated from the body.	
134.	26818	Only upper register ext. Inscription: 6 signs. A oblique stroke with curvature suggest that it could horn of unicorn. Knob: missing. All white steatite seems to be classical, made-to-order type.	
135.	27192	R half of a very tiny seal broken at perforation. Inscription: 2 signs	
136.	27511	Small frag of possibly square seal with 1 symbol partially preserved, grey steatite coated white & glazed	
137.	29433	Unicorn horn, head, neck missing, the remaining well preserved, pipal leaf-shaped, spread on withers present Inscription: missing Knob: round, grooved, & perforation partly present	

Sl. No.	Acc. No.	Remarks	
138.	31420	Inscription 3 signs	
139.	31655	Animal only small part of body visible-difficult to recognize the animal Only upper right and top part ext. Inscription: about 7 signs, Knob missing	
140.	32457	Inscription: 3 signs unique as a rectangular seal with an Indus knob that is partly missing. Perhaps, possibly only one such example from stage IV & V	
141.	32533	Inscription vaguely visible	
142.	32684	Unicorn, standing to L, wrinkled neck spread on withers; manger 2 tiered. Inscription: 3/4 signs. Knob: round, grooved, perforated, partly missing	

Sl. No.	Acc. No.	Remarks	
143.	33253	*Bos taurus* lowering head over a trough; Inscription about 6 signs. Knob: round, perforated but present in traces as it is knocked off. The seal all white steatite fissures & damaged particularly on the back are alarming	
144.	33514	R upper corner of a seal Motif in indistinct traces. Inscription: 2 signs and 3rd traceable as extant. Knob: square, round, perforated and partly damaged. All white steatite.	
145.	33515	Unicorn, standing to L, manger in traces. Inscription 3-4 signs. Knob: round, grooved, perforated all white steatite, extremely, on the verge of being exploded	
146.	33516	Unicorn, standing to L, wrinkled neck. Manger 2-tiered. Inscription. 6 signs Knob: round, grooved, perforated; all white steatite. Classical Made-to-order type.	

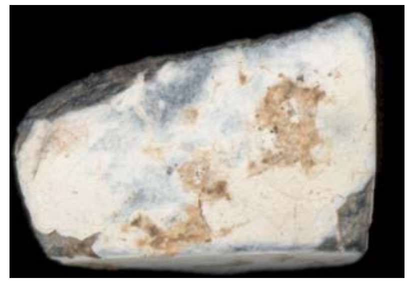
Sl. No.	Acc. No.	Remarks	
147.	33526	Unicorn Standing to L, muzzle, horn and hind body missing as upper L corner damaged and some R side part missing. Inscription: 2 signs traceable knob: round, grooved. All white steatite. Classical made-to-order type.	
148.	33542	Inscription: 3-signs. Complete.	
149.	33544	Very tiny seal with 1 sign followed by four vertical strokes. Perforation partly broken. Since found in upper level it could belong to Stage VI	
150.	33959	Unique at Dholavira as rectangular with square cross section, highly shiny. Broken at perforation Inscription: 4 signs, one being partly missing. No knob, vertical perforation in the thickness. The area it comes from is despoiled by the late Harappans. So Stages indeterminate	
151.	34492	R half broken at perforation Inscription: 1 man-sign. Intrusive in MT	

Sl. No.	Acc. No.	Remarks	
152.	34566	It seems square seal was knapped round to make another one by erasing original features but, left incomplete, grouped round boss is intact.	
153.	34881	Less than 1/4 of seal Inscription only 2 signs extant. Round, grooved, perforated knob, partly missing	
154.	35320	Less than half of lower part only extant. Beautifully crafted tiger, standing to L, upper part of the head is missing, so is the upper body and considerable part of hind body missing although legs and tail preserved a trough placed under in the front. Inscription, if any, missing now. Boss round, grooved, partly preserved.	
155.	36002	Only manger partially preserved; the rest missing	
156.	37021	A fine square white coated grey steatite seal having cream colour bands, complete but 1/2 half of the obverse a chipped off. Animal standing to L, only part of hind side extant. Inscription 2 signs present. Knob: round, grooved, perforated. Classical, made-to-order type.	

Sl. No.	Acc. No.	Remarks	
157.	38712	Less than 1/4 ext-R upper corner. Animal standing to L (possibly unicorn as traces of spread on withers visible). Inscription: 2 signs + 1 partly visible Knob round, grooved, with perforation all white steatite, classical, made-to-order	
158.	38885	Only lower L, corner lower part of a manger, and possibly a leg of an animal all white steatite	
159.	38996	Black steatite seal fragment. Inscription: 3 signs, No knob no perforation	
160.	39031	Sub Indus scene visible on upper R corner of seal All other details missing.	

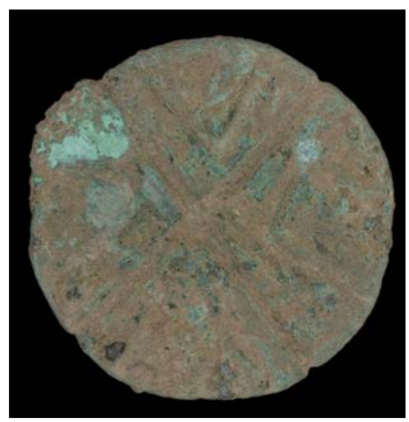
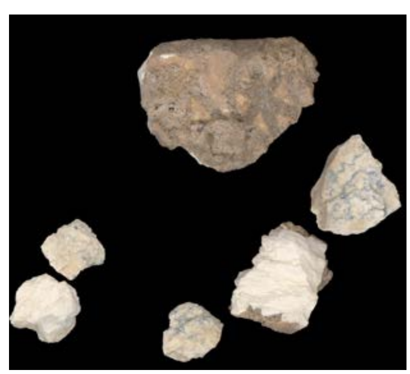
Sl. No.	Acc. No.	Remarks	
161.	39152	L, part possibly with 2 signs	
162.	39153	Complete, all creamish white steatite seal Unicorn, standing to L, wrinkled neck, withers-spread present. Two-tiered manger Inscription: 5 signs. Knob: round, grooved, perforated. Classical, made-to-order type.	
163.	39158	Inscription: illegible Workmanship poor perforation on the back.	
164.	33692	Inscription. 4 signs horizontal perforation	
165.	33693	L half ext, perforation missing wagon-vault back Inscription 2 signs	

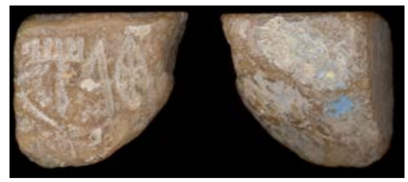
Sl. No.	Acc. No.	Remarks	
166.	54399	Animal, (probably unicorn), standing to L horn, head, neck missing, probable place of manger damaged. Inscription: 3 signs preserved, other damaged Knob: round. Grooved, perforated Badly fissured, chipped, treated with adhesive.	
167.	34894	Crudely executed. Animal (probably unicorn) standing to L Inscription: some signs are visible but all very difficult to figure out. Knob: square, perforated. Seems to be an apprentice's work	
168.	18264	Animal, standing to L, only long tail & one hind leg visible. All white steatite	
169.	217	Unicorn standing. to L, hind legs missing. 2-tired manger Inscription: in a tiny trace Knob: round, grooved, perforated & partly damaged; lower right corner & upper field missing	

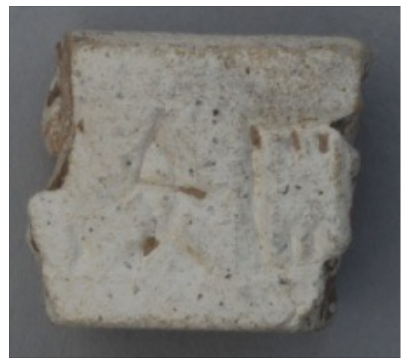
Sl. No.	Acc. No.	Remarks	
170.	24138	Very tiny fragile an withering seal Inscription 3 strokes	
171.	48323	Small part of corner ext. no details	
172.	33247	Buffalo, (unusually, standing to R, wrinkled neck, long horns. No Inscription. Knob: square, perforated vertically. Grey white steatite	
173.	49038	Unicorn standing to L, wringed horn wrinkled neck and a garland and a spread on withers. 2-tiered manger placed under the head. Inscription 3 signs. Knob round and grooved but split open. It is classical standard seal with masterly execution, albeit much used and worn.	

Sl. No.	Acc. No.	Remarks	
174.	50845	A tiny black steatite unfinished seal with poor engraving. Unicorn, standing to L, 2-tiered manger. Inscription: 2 signs clearly visible. Knob: square unperforated.	
175.	49150	About 1/2 half missing Inscription: 3 signs one partly damaged. Knob: Perforation present	
176.	50395	Bos taurus, with lowered head, over trough partly worn out. Inscription. 4 signs, 5th partly damaged, boss lost, perforation clear very important and rare. Knob, round standard, knocked off Most importantly is only round steatite seal found at the site. Furthermore 2 man signs, one holding a staff appears on a Persian Gulf round seal by K.M Srivastava team.	
177.	48567	*Brahmani* bull, standing to L, with curved horns, a large hump and huge dewlap; 1 horn is partly chipped so is the upper L corner; a masterpiece, Inscription: single sign, round grooved. Knob with horizontal perforation	

Sl. No.	Acc. No.	Remarks	
178.	49820	Unicorn standing. to L, wrinkled neck; manger under head. Inscription 2 signs upper right corner slightly damaged, lower left slightly worn classical made-to order seal with standard round grooved boss.	
179.	50318	Animal appears to be 2-horned unicorn (rare), standing. to L, head held high. A deep (high) U shaped vessel under the head. Inscription: 1 double rake symbol it a tiny seal with a simple, curved boss with boss.	
180.	48931	Unfinished. To deep cut vertical strokes on either side but the central one, wheel sign is lightly engraved no perforation, although to dents on either side of the curved back suggest of intended perforation. 2 strokes one straight, the other slightly curved are engraved on the curved back. a small part of one side missing	
181.	51222	Horizontally cracked. Knob separated. Inscription traces of signs visible. Found in the debris of lying outside castle wall.	

Sl. No.	Acc. No.	Remarks	
182.	54387	Heavily weathered and fissured. Unicorn, standing to L, head & horn partly damaged, pipal leafed spread visible, hind part partially missing; 2-tiered manger. Ins: 6-7 signs, but not very legible. Knob: seems to be standard one but largely flaked off, perforation present	
183.	54388	Only central part of the animal with pipal leaf spread, is partially ext, head & horn in faint traces, hind part much of upper body missing, including. Inscription: manger 2- tiered. Knob: missing. Execution- superb. Mottled grey steatite, painted white	
184.	54390	Rare, solitary round copper seal with geometric motif-field divided into forth part by across, each part with 3 triangles. Back slightly curved. Difficult to say whether it had something for suspension.	
185.	54391	No details	

Sl. No.	Acc. No.	Remarks	
186.	54392	Complete seal Unicorn standing to L, pipal leafed spread on withers. Manger 2-tiered. Inscription: 3 signs. Knob: round, grooved, perforation. Khaki steatite coated white. Small seal with fine execution. Classical, made-to-order type.	
187.	20131	Only R upper corner, possibly of a square seal A oblique stroke below Inscription looks like horn of unicorn- if so must be standing to LEFT Inscription: 3 signs extant, Knob missing. Khaki steatite coated bluish white & grazed.	
188.	24732	Lower L less than half. Unicorn standing to R, wrinkled neck horn and hind part missing. 2-tiered manger. Knob: missing trace of perforation visible. The material is grey yet to be identified	
189.	37432	Unicorn standing to L, lower body chipped off. Inscription 4 signs standard round grooved knob with perforation.	
190.	49846	Inscription. 4 signs visible, 5 one possibly worn out	

Sl. No.	Acc. No.	Remarks	
191.	3693	Unicorn, standing to L, all other details either gone or heavily patinated. Knob: round, grooved, perforated. classical made-to-order type. A badly cracked, fissured and patinated.	
192.	39439	Broken half. Inscription 3 signs extant	
193.	40471	Central part with perforation thro’ thickness. Inscription: 2 signs. Its occurrence from the mature Harappan stratum is curious. It could be from stage VI. Off-white kaolinite with bluish tinge on surface, Traces of saw marks visible.	
194.	40791	Inscription: 3 complete signs & 4th partially preserved. Well-cut and balanced in size. Animal, standing to L, only upper body part, tail and faintly one leg visible. Knob: standard, round, grooved, perforated – partly preserved. Classical made-to-order type, glazed all over Nearly less than 40%, extant	
195.	40792	Goat, with long horns curved backwards, tail upturned, four or five rings on the neck, beard visible. No any object placed on the ground in the front. No inscription. Knob curved and perforated	

Sl. No.	Acc. No.	Remarks	
196.	41036	Inscription. 4 signs	
197.	42428	Obliquely broken across the width only lower part and back flaked off. Well-crafted, animal prob. unicorn, standing to L, 4 legs, long tail and lower part of body with genital, pipal leave spread drawn in two parallel lines is partly visible, part of manger.	
198.	42429	Animal, unusually standing to R, instead of L, only hind part with two legs and long tail and part of body extant. Inscription: 2 signs partly visible in upper register. Trace of knob visible.	
199.	41434	A tiny piece showing motif but not clear. Knob partly preserved	
200.	41836	Inscription: 3 signs-one fairly complete other two in traces. Interestingly the curved back wears red coat	
201.	43037	Less then left half Bos taurus lowering head over a trough, only front part with horns, head, ear, wrinkled neck one leg in trace Inscription. 1 sign complete 2 signs partly	
202.	43421	Rectangular face is largely shiny black. No perforation either	
203.	43486	Vertically split half. Inscription: 2 signs full & 3rd one partly preserved. Shiny black	

Sl. No.	Acc. No.	Remarks	
204.	43885	Surely unicorn standing to L, only hind half preserved split vertically into half with animal appears to be unicorn represented by only hind half along with 3 signs of inscriptions. All white steatite	
205.	44145	Split horizontally. Bears Inscription. Partially present 3 signs	
206.	45047	Motif in traces, too small for identification. Inscription: 4 signs completely & 5th partly extant. All white steatite seal, Knob is missing. Seems to be classical, made-to-order type.	
207.	45285	Lower R only. Animal, standing to L, hind body with legs & tail. Bodily delineation and crafting shows a robust well-made animal which is closer to a unicorn. Knob missing, with faint traces.	
208.	54393	Unicorn standing to L, garland in neck. 2-tiered manger. Inscription: 2 signs part of back and Knob missing, should have been round, grooved, trace of perforation present a hear & crack upper L, corner. Classical, made-to-order type.	
209.	6226	No details one side flaked off	

Sl. No.	Acc. No.	Remarks	
210.	19787	Unfinished a tiny seal of buff steatite. Inscription: 2 sign fairly traceable but difficult of being figured out no perforation	
211.	16863	Grey steatite coated with white. A small frag with traces of science	
212.	19577	Raw, unbaked light grey steatite piece could have cut into a square piece	
213.	54395	No details	
214.	54284	A tiny piece of lower left part showing one vertical stroke, possibly of manger and one leg	
215.	54398	Goat with forwardly curved horns wrinkled neck and upturned tail; a triangle on a vertical stroke placed under head. Inscription a pipal leaf in R upper part. Most significant as the perforation is fitted with a copper ring.	
216.	47242	1/3 part of tiny seal missing. Inscription 1 sign full 2 sign partly preserved	
217.	51582	Inscription: 4 signs. R slightly missing. All white steatite. Knob: triangular back with curved apex, horizontal perforation.	

Sl. No.	Acc. No.	Remarks	
218.	52359	Only central part with perforation; rectangular face deeply scratched.	
219.	52238	Unicorn, standing to L, lower L missing hence muzzle also missing,, horn ,wrinkled neck & withers-spread present; manger slightly visible Inscription: 6 signs. Knob: round, grooved, perforated	
220.	53247	Central, lower, & part of L side too damaged for details. Inscription: 4/5 signs visible. Knob: round, grooved, perforated. All white steatite. A classical made-to-order type.	
221.	53254	*Bos taurus*, standing to L, with head, lowered over a trough, wrinkled neck. Inscription: 5 signs. Knob: round, grooved, perforated. All white complete steatite seal, classical made-to-order type.	
222.	54394	Seems to have been broken at the time of being manufacturing	

Sl. No.	Acc. No.	Remarks	
223.	10616	In Nat.Mus	
224.	24795	In Nat.Mus	
225.	20013	In Nat.Mus	

8.2.4 Seallings

The sealings from Dholavira are mostly from Stages IV and V. The sealings have been found in hard baked condition. The colour of the sealings varies from grey, greyish red, dull red, black, etc. A total of 61 sealings were documented out of which the period could not be determined for four. The period of remaining 59 sealings was determined and shown below in the pie-chart:

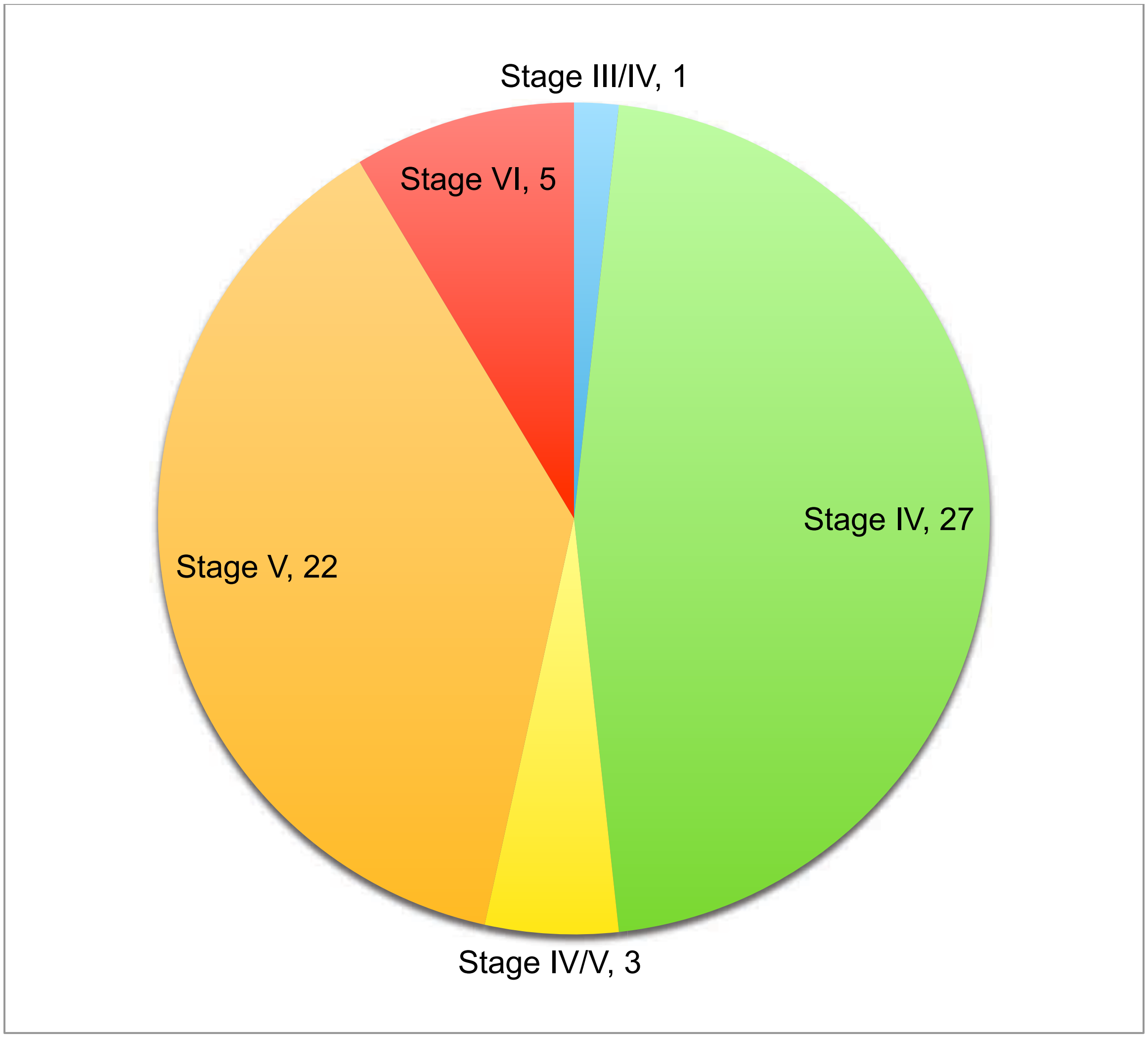


Fig. 8.27: Pie chart showing the period-wise distribution of sealings

The analysis indicate an overwhelming 52 sealings from mature Harappan phase, i.e. Stages IV and V, while 5 are from Stage VI.

A detailed description of the sealings found from the Dholavira excavation arranged stage-wise is given below:

Sl. No.	Acc. No.	Details	Period	Photograph
1.	17516	Locus: Castle, surface		
2.	17313	Fragment, burnt grey. Locus: Middle Town, 44 x 43 x 2, stratum: pit sb. layer 1(mixed debris), depth: 42 cm. Stage indeterminate Obv.: stamp on a semi circularly curved surface showing 3-Signs intact, one on either side faintly visible Rev.: semi circular depression bearing some vegetation marks. Seems to have been attached to a cylindrical body. Right & lower parts missing.	Uncertain	
3.	49292	Right part missing, upper & left side margins of seal intact, burnt muddy red. Locus: East Reservoir, 37 x 77 x 1, stratum: 3, depth: +44 cm. Stage indeterminate. Obv.: 2 seal impressions, 2 signs fairly intact, the rest partly missing Left side beers a semi-circular impression, indicating attachment to a circular or semi-circular object, like a handle of a door, right side has a straight face	Uncertain	
4.	3003	Perhaps round sealing, with right side missing, burnt grey	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
		Locus: Castle, XE 22/2, stratum: 23, depth: 380 cm. Obv.: 6 signs preserved on a curved surface, lower & upper edges of seal partly preserved. Rev.: upper part is much depressed, making a rough surface, lower part beers a semi-circular impression trending vertically.		
5.	3130	Fragment, right side missing, burnt red. Locus: Castle, XE 22 x 1, stratum: 14, depth: 175-235 cm. Obv.: 1-sign inscription intact, right side missing. Rev.: left side semi circular, with 3 fingernail marks. Perhaps it may have been a somewhat cylindrical sealing, preserved to a depth of 12.5 mm. it was perhaps affixed into the mouth of a pot or in a fixture of a door.	IV	
6.	5090	Fragment, burnt grey Locus: Castle, 48 x 92 x 2, stratum: 24, depth: 320 cm Obv.: impression of a square seal is clear, two signs of an inscription, one complete another partially present. Rev.: Edge of container & some impression, possibly of coarse textile, visible	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
7.	11157	Fragment having red surface but unoxidized black core. Locus: Middle Town, 35 x 54 x 1+2, stratum: 9, depth: 97-110 cm. Obv.: 3 signs of inscription are visible. Down below some motif, possibly a bull is faintly visible; the piece is badly broken & fissured. Rev.: flat surface with no features.	IV	
8.	5409	Fragment of somewhat cylindrical sealing, with both longer & cylindrical sides missing, burnt black Locus: Castle, 48 x 92 x 3+4, stratum: 29, depth: 465-500 cm Curiously, It beers parallel lines running round the object.	IV	
9.	16929	Circular token sealing, burnt grey. Locus: Middle Town, 55 x 60 x 2, stratum: 4, depth: 135 cm. Obv.: unicorn, standing to right, with a manger below & a 2-sign inscription above within the incuse of square seal. Rev.: curved back having no features.	IV	
10.	25872	Fragment of tiny oval sealing, right side missing. Locus: Lower Town, 25 x 94 x 1, stratum: 3, depth: 52 cm. Obv.: some signs present.	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
		Rev.: some lines, possibly of vegetal material visible.		
11.	3556	Fragment, some upper & lower parts missing. Locus: Castle, XE 22/1, stratum: 22, depth: 375 cm. Obv.: impression of a tiny square seal bearing unicorn, stg. to right, lower body missing & two or three signs of inscription extant while third one partially visible. Rev.: Some impressions visible but not clearly recognizable. It was perhaps an oval sealing.	IV	
12.	13313	Fragment, burnt red. Locus: Castle, 57 x 20 x 2, stratum: 8, depth: 215 cm. Obv.: curved surface with 3 intact signs, some signs on either side missing. Rev.: curved surface with a downward slope & with a small circular depression from which clay has flown out forming a long tongue. Sealing seems to be affixed on a cylindrical form, either on the neck of a pot or a wooden handle.	IV	
13.	51615	Somewhat circular tiny sealing, with right side part missing, burnt red.	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
		Locus: Castle, 47 x 73 x 3, stratum: 19, depth: 372 cm Obv.: incuse of square seal, with 2- signs almost complete, third one indicated, the rest missing. Rev.: semi-circular vertical depression is partly preserved with smooth surface with no other features.		
14.	53849	Fragment of circular sealing, burnt light red. Locus: Castle, 47 x 74 x 4, stratum: 18, depth: 345 cm. Obv.: left side of margin of seal is partly extant, right side missing, only one sign inscription is preserved. Rev.: flat & rugged.	IV	
15.	53919	Fragment, burnt grey & partly red. Locus: Castle, 47 x 74 x 4, stratum: 18, depth: 370 cm Obv.: only three Indus signs preserved, part of upper right & left side missing. Rev.: semi-circular depression, indicating is attachment to a cylindrical, stick-like object. Its surface is very smooth.	IV	
16.	53812	Fragment of small but thick sealing, perhaps oval in shape, right part obliquely broken. Locus: Castle, 47 x 74 x 4, stratum: 16, depth: 320 cm.	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
		Obv.: upper margin of seal is partially preserved, 2 Indus signs completely present while third one is partially indicated. Rev.: thread marks running criss-cross on the rugged & depressed surface.		
17.	53920	Fragment, right side & partly lower side missing, burnt muddy red. Locus: Castle, 47 x 74 x 4, stratum: 18, depth: 370 cm. Obv.: impression of seal, perhaps square is partly preserved with 3- Indus signs, one being partly missing. Rev.: only one deep & vertical depression is present.	IV	
18.	23155	Tiny, thin fragment burnt light yellow colour. Locus: Bailey, 57 x 57 x 2, stratum: 26, depth: 469 cm. Obv.: there are some partially preserved symbols, on a tiny piece with two margins intact the remaining being missing. It is very difficult figure out whether symbols are part of Indus signs or not. Rev.: no features.	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
19.	18035	Very tiny fragment, burnt red, with a thin blackish film on the surface. Locus: Bailey, 57 x 99 x 4, stratum: 3, depth: 196 cm. Obv.: one in the sign complete, the other partially extant. Rev.: damaged.	IV	
20.	17491	A very tiny fragment, burnt light red Locus: Middle Town, 55 x 60 x 3, stratum: 3b, depth: 105-117 cm. Obv.: two edges, making a right angle, is partially preserved, showing that stamp of a seal, possibly square. Very small portion of motif is preserved, but it is difficult to figure out. Rev.: too small for any observation.	IV	
21.	17490	Intact circular token sealing, burnt light red Locus: Middle Town, 55 x 60 x 3, stratum: 3b, depth: 110 cm. Obv.: incuse of square seal, unicorn, stg. to right, manger on the ground, inscription in the upper register but illegible. Rev.: curved back with no special features.	IV	
22.	16574	Fragment of circular sealing, lower part missing, burnt blotchy red.	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
		Locus: Middle Town, 56 x 54 x 1, stratum: 3c, depth: 124 cm. Obv.: incuse of square seal partially preserved, 3-sign inscription. Rev.: faint traces of grass.		
23.	45970	Fragment of curved sealing, much of it missing, brunt red. Locus: Castle, 47 x 63 x 3, stratum: 20, depth: 370 cm. Obv.: only one sign partially preserved. Rev: Semi-circular depression, possibly of a round one is extant nature of object on which the sealing was attached not clear.	IV	
24.	2729	Tiny fragment, all sides considerably missing, brunt black. Locus: Castle, XE 22/2, stratum: 20, depth: 316 to 341 cm. Obv.: Left side incuse of seal partially preserved, only one sign extant. Rev.: Curved, possibly impression of a cylindrical object.	IV	
25.	44342	Fragment with curvature on upper part above seal impression, all sides missing, brunt black. Locus: Middle Town, 46 x 71 x 3, stratum: 5, depth: 210	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
		Obv.: Upper margin of seal partially preserved, 3 signs only extant on lower part of sealing, three fingernail marks, obviously of the person who pressed the clay, are on upper curved side Rev.: A semi circular smooth depression running vertically, possibly of read.		
26.	51493	Fragment, upper lower & right sides missing, core brunt red with a thin film all extant surfaces-obverse & reverse. Locus: Castle, 47 x 73 x 3, stratum: 18, depth: 336 cm. Obv.: Impression of 3 stamps, one above another, the uppermost one slightly preserved, on central one three complete and one partially preserved Indus signs present, on the lowermost one too complete and one partially extant, the upper left corners of the lower too stamps are clearly visible and right margin of the upper one slightly visible. Rev.: A part of the backside is partially preserved with a smooth surface, a deep vertical depression is visible in the damaged part.	IV	
27.	45046	Fragment, brunt red. Locus: Middle Town, 46 x 71 x 3, stratum: 20, depth: 410 cm, Obv.: Impression of upper margin of seal partially preserved, 3 Indus sings partially visible. Rev.: Upper part has an outward slop & lower part is recessed; both parts have some horizontally running impressions.	IV	

Sl. No.	Acc. No.	Details	Period	Photograph
28.	46749	Fragment, brunt red. Locus: Annexe, 48 x 98+99, stratum: 8, depth: 460 cm. Obv.: Slightly curved surface bearing impression of upper edge of the seal partially preserved & under it are three complete one partially extant sings. Rev.: one semi-circular, vertically trended, impression along with some other indistinct ones visible.	IV	
29.	31090	Fragment of a tiny sealing, with curved surface, upper part sloping, brunt red. Locus: Promenade to the west of East Reservoir, 37 x 75 x 3, stratum: 6, depth: 215 cm. Obv.: Only two signs are partially preserved. Rev.: Impressions not definable.	IV	
30.	31094	Tiny fragment of small sealing, curved surface, brunt grey. Locus: Promenade to the west of East Reservoir, 37 x 75 x 3, stratum: 6, depth: 225 cm. Obv.: One sign completely, another partially preserved. Rev.: Impressions not clear	IV	
31.	1506	Fragment of an oval sealing, burnt muddy red.	IV/V	

Sl. No.	Acc. No.	Details	Period	Photograph
		Locus: Castle, E 19, Mixed debris, depth: 155 cm. Obv.: stamp on one sign intact while, right side is blurred partly missing Rev.: impression of knotted threads.		
32.	2618	Fragment of small sealing, upper part missing, burnt red. Locus: Castle, E. 19/ 3, stratum: 7A (Mixed debris), depth: 145-150 cm. Obv.: 2 signs, one partly missing Rev.: impression of motif very faint, difficult to recognize. Seems to be a part of a circular sealing.	IV/V	
33.	4608	Large, complete piece, burnt red. Locus: Bailey, XH 34, stratum: 2, depth: 45 cm. Obv.: two stamps nearly one above another, showing unicorn, standing to right, with 2-tiered manger placed in the front under the head of the animal; 3-sign inscription in the upper register. Rev.: a right-angled impression in the lower side, indicating its attachment to an square/rectangular box.	IV/V	
34.	24718	Fragment of a large sealing, brunt brick red. Locus: Middle Town, 59 x 11 x 4 stratum: 5, depth: -80 to -90 cm.	IV/V	

Sl. No.	Acc. No.	Details	Period	Photograph
		Obv.: Impression of a seal only partially preserved with two complete sign and one in faint trace present. Rev.: Two vertical, semi-circular depressions possibly of reed.		
35.	30240	Circular, obliquely broken, burnt red with black core. Locus: Middle Town, 55 x 93 x 2, stratum 2, depth: 32 cm Obv.: stamp of a square seal in a circular sealing, one full sign, another partly extant, animal, stg. to right, head missing Rev.: a slight depression visible. It may be a token or a pass.	V	
36.	31092	Circular, broken obliquely into half, burnt red Locus: East Reservoir, 37 x 75 x 3, stratum: 6, depth: 220 cm. Obv.: 3 signs of inscription partially extant, in lower register upper part of an animal, stg. to right, is faintly visible, albeit much blurred. Rev:. a semi-circular depression, running vertically, is partially present. It appears that it was attached to a cylindrical feature.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
37.	37434	Amorphous fragment, burnt red. Locus: Middle Town, 35 x 63 x 4, stratum: 6, depth: 63-65 cm. Obv.: one sign largely & two signs, one each on either side, very partially present. Rev.: largely knocked off. A faint impression of its attachment to an object is present.	V	
38.	54401	Nearly complete sealing, somewhat circular, burnt greyish red Locus: Middle Town, 45 x 93 x 2, stratum: 2, depth: 28 cm. Obv.: two vertical lines in the centre & four dot- in circles, one each in four corners. Rev.: Two lines criss-crossing each other on a flat surface with a deep depression in the centre, obviously, thread & knot marks are indicated.	V	
39.	6836	Fragment, burnt red Locus: Castle 47 x 9 x 3, stratum: 2, depth: 10 cm. Obv.: 5 complete signs & 6th one partly present. Lower part largely missing incuse of a square or rectangular seal visible. Rev.: deep indentation are present on somewhat flat face, including a small piece of pottery, firmly ingrained in the fabric, suggesting that it got detached from the container while the sealing was being removed.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
40.	17466	Circular, almost complete sealing, with right side part being straight. Locus: Middle Town, 55 x 60 x 3, stratum: 3B, depth: 105 cm. Obv.: An animal, most possibly unicorn, stg. to right; 2-sign inscription in the upper field. Incuse of the seal is partly visible in the upper part. Rev.: Convex-shaped with no features. It may be a token or a pass.	V	
41.	18601	Fragment, burnt red with black patches. Locus: Castle 47 x 48 x 1, depth: 127 cm Obv.: 3-signs preserved, lower part badly damaged Rev.: flat surface with no special features.	V	
42.	4368	Fragment of an oval sealing, burnt greyish black. Locus: Castle, XF 23/4, stratum: 4 Obv.: 2 crescents engraved, perhaps by fingernail, on the curved surface. Rev.: raised features, alternately forming a rhombus & a line, are repeated twice in a row.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
43.	15378	Fragment, right side missing, burnt red, with the surface having a thing greyish film. Locus: Middle Town, 55 x 55 x 2, stratum: pit 1 sb. layer 1, depth: 35 cm. Obv.: impression of a seal, with 2-signs, incuse is visible. Rev.: slightly curved bearing vegetal marks.	V	
44.	17064	Fragment of a tiny oval sealing, burnt grey. Locus: Bailey, 58 x 11 x 3, stratum; 2, location: +44 to +9 cm. Obv.: one sign partly extant. Left & upper edges of stamp seal present.	V	
45.	20502	Fragment of an oval sealing, burnt grey. Locus: South Reservoir, 48 x 45 x 4, stratum: 7, depth: 312 cm. Obv.: incuse of a square seal, with one sign of inscription, where is right part is largely missing. Rev.: impression of textile on flat surface visible.	V	
46.	54400	Fragment of seemingly circular sealing, burnt greyish red.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
		Locus: East Reservoir, 37 x 44 x 3, 37 x 45 x 4, stratum: 7, depth: 115 cm. Obv.: one stamp, showing an animal, most possibly Bos taurus with lowered head, some details partially missing; 4-sign inscription in upper register. Rev.: one semi-circular impression, running vertically. It may have been attached to a round stick-like feature.		
47.	51597	Irregularly square sealing, with partly damaged at two places; burnt red. Locus: Middle Town, 55 x 86 x 4, stratum: 3, depth: 52 cm. Obv.: two stamps, one on the thick top in the upper side, the other at the lower end, the central part, comparatively much large, is flat & smooth with no motif. On the first one perhaps three Indus signs, & on the lower one 3 or 4 signs preserved, but not all very clearly. Rev.: the preserved part is smooth on one corner & rugged on the rest, showing no special features. Rev.: Most of the sealings are without motifs, suggesting that only the inscribed part was used for stamping. Only on a token motif was used normally.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
48.	17465	Circular, intact, token sealing, burnt light red Locus: Middle Town, 55 x 60 x 3, stratum: 3b, depth: 150 cm. Obv.: unicorn, stg. to right, with 2-tiered manger, 2-sign inscription in upper register. Stamp seal should be square, left margin of what is largely preserved Rev.: curved back has no features. It should be a token for identification or authorization, etc.	V	
49.	22455	A very tiny fragment burnt light grey. Locus: Lower Town, 25 x 2 x 4, stratum: 3, depth: 48-54 cm. Obv.: Only one Indus sign is preserved. Rev.: damaged.	V	
50.	18203	Fragment, showing different levels of stamping, outer side burnt red, underside black. Locus: Bailey, 58 x 11 x 3, stratum: 2, depth:+97 to +20 cm. Obv.: three different levels are extant, each level is stamped with a row of vertical strokes by some stamping device. Rev.: vertically curved, indicating that it was attached to a cylindrical object may be of wood.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
51.	7873	Fragment of a circular sealing, ¼ part extant, upper & left sides missing burnt grey. Locus: Castle, 47 x 10 x 1, stratum: 1, depth: 20-25 cm. Obv.: two Indus sign partially preserved Rev.: semi-circular with multiple vertical lines. Seems to be attached to a cylindrical object.	V	
52.	43884	Fragment of a circular sealing, ¼ part, upper & right sides missing, burnt red. Locus: Middle Town, 55 x 77 x 3, stratum: 2, depth: 55 cm. Obv.: Impression of two stamps-upper one with right-angled incuse of the seal present, one complete & one partially visible Indus signs extant; upper seal margin & impression some signs very partially preserved has difficult to figure out. Rev.: Undulating with no clear features.	V	
53.	12173	Tiny fragment with a curved surface, & upper & lower parts sloping, brunt red. Locus: Middle Town, 35 x 94 x 2, stratum: 2A, depth: 60 cm Obv.: Curved surface one complete & one or two indistinct signs. Rev.: Some unidentifiable impressions.	V	

Sl. No.	Acc. No.	Details	Period	Photograph
54.	44897	Complete token sealing, rectangular in shape brunt light grey. Locus: Middle Town, 45 x 68 x 1, stratum: 2, depth: 41 cm. Obv.: Impression of lower left corner of seal partially present, 2 signs visible others blurred. Rev.: flat & smooth	V	
55.	30239	A fragment of large sealing all sides missing, brunt grey. Locus: Promenade to the west of East Reservoir, 37 x 44 x 2, stratum: 2, depth: 50 cm. Obv.: One complete & another partly extant signs with hind part of an animal, standing to right extant. Rev.: Smooth & curved back with a shine. It is obviously stamped with a classical seal.	V	
56.	29262	Fragment of oval sealing right part missing, surface curved, brunt red. Locus: Promenade to the west of East Reservoir, 37 x 75, stratum: 5, depth: 60 cm. Obv.: Three signs extant. Rev.: Two horizontal semi-circular depressions visible.	V	
57.	312	Part of a circular sealing, with right upper part missing, burnt greyish red.	VI	

Sl. No.	Acc. No.	Details	Period	Photograph
		Locus: Castle 47 x 85 x 4, stratum: 6, depth: 75 cm. Obv.: 3 sign inscription, intact, 4th one partially visible upper & left sides show the seal margins. Rev.: reed impressions.		
58.	35028	Half part of a oval sealing, burnt red. Locus: Castle, 47 x 64 x 3, stratum: 2, depth: 38 cm. Obv.: two raised semi-circular lines running parallel on a flat surface. It is not clear whether it could be an Indus sign or a symbol. Rev.: perhaps impression of threads criss-crossing each other.	VI	
59.	30241	Less than half part of a circular sealing, burnt grey. Locus: East Reservoir 37 x 44 x 2, stratum: 2, depth: 50 cm. Obv.: incuse of sealing partly visible. Rev.: two depressions visible. Interpretation is difficult.	VI	

Sl. No.	Acc. No.	Details	Period	Photograph
60.	50395	Large fragment, burnt red, the lower part missing. Locus: Castle, Tank 1, 47 x 98 x 1 Obv.: impression of a square seal, 2.5/2.5 cm, showing unicorn, stg. to right, with 2-tiered manger & 5/6 signs of inscription in the upper register. Rev.: impression of grass & one stem.	VI	
61.	43884	Fragment, which slightly curved surface, all sides missing, brunt red. Locus: Castle, 47 x 75 x 4, stratum: 1, depth: 120 cm. Obv.: Incuse of upper right corner of seal present, 3 signs extant. Rev.: Two semi-circular the impression running vertically, probably reed impression.	VI	



Fig. 8.28: Sealings from Dholavira excavation



Fig. 8.29: Sealings from Dholavira excavation



Fig. 8.30: Sealings from Dholavira excavation

8.2.5 Terracotta Tablets

Two tablets made of terracotta have been recovered from the excavation. The details of which are given below:

1. **Acc. No. 8099- Plano-convex tablet, with stamping on both faces, prepared** from two separate moulds, Stage IV. Locus; Lower Town, near east gate of Middle Town, 35 X 34 X 2, stratum 8, depth 252 cm, size L- 35, height- 6 mm, burnt muddy red, right side slightly damaged.

   Flat face bears 5- sign inscription on the left side, and a mythological scene on the right. The scene depicts a human firmly seated on the ground, with right leg drawn at right angle, left leg knelt with the foot raised perpendicularly

and the toe touching the ground, and holding one human each by waist in outstretched hands, lifting each one high in the air; both the victims have their hair tied in a burn and are much smaller than the central figure.



Fig. 8.31: Details on the flat surface of terracotta tablet



Fig. 8.32: Details on the curved surface of terracotta tablet

The curved face bears a mythological scene comprising two crocodiles, and a combat between a human or a deity and a bull-man. One crocodile each, shown across the width of the tablet, flank the combat scene in which the man on the right is striking the bull-man on the left. Most striking is the dress of the human figure, which wears a peaked cap, or a headgear of two horns, putting on a tunic, parted open below the knees, and also has long boots with upraised toes. The man is about to strike the bull-man, probably with a club-

like weapon, held in his left hand while with the right is holding the right hand of the bull-man, with his left hand is raised up words with a bend at the elbow Bull-man has long, outstretched, curved horns, a large hump, a long tail and bovine legs with hooves.

The long tunic, peaked cap and high boots with upturned toes are strongly reminiscent of the Central Asian attire. Its find from almost the upper middle of the Stage IV is highly significant. Anyway, the Harappans had established a town at Shortughai in Badakhshan (north Afghanistan); the evidence may not be surprising, however. In the late phase of the Harappan period the trade relations with the Bactria Margiana Archaeological Complex region seems to be regular.

2. Acc. No. 10203. Locus: Lower Town 25 X 94 X 1, stratum: 3, depth: 52 cm. Stage V.

It is a square piece of a bifacial tablet with some partially present features on both sides. On one side, two signs are partially preserved while on the other a *svastika* symbol is noticed.

8.3 Weights and Measures

One of the hallmarks of the Harappan Civilization is the weights and measures and their standardisation achieved throughout the length and breadth of its territory. The earliest excavations at Harappan and Mohenjo-daro during the beginning of last century brought to light among all classical elements of the Harappan Civilization, a distinct and highly developed and standardised weighing system. A.S. Hemmy was one among the earliest scholars to have a detailed account of weights from Mohenjo-daro (1931) and Chanhu-daro (1943). Later, M.S. Vats (1999) gives an account of the weights found from the excavations at Harappa. Hemmy (1931) summarizes his approach of finding the probable value of the unit as follows:

> *"…the weights fell into a series of groups which were in simple numerical ratios with one another. Giving the smallest the arbitrary value of unity, the others are in simple ratios, r, 4, 8, etc. The mean weight of each group is divided by this ratio and multiplied by the number of specimens. The products for all the groups are added together and divided by the total number of specimens. This give a mean value for the group of smallest weight in which every specimen weighed is allowed equal importance. The mean values for all the other groups are then obtained by multiplying this mean value by the ratio already found…"*

Hemmy (1931) identifies two series at both Harappa and Mohenjo-daro and also concludes that there is *'….no local variation between the weights in the two places, although 500 mile apart.'* Hemmy (1931) also notes that the sequence of ratios is striking which runs as 1, 2, 4, 8, 16, 32, 64, 160, 200, 320, 640, 1600, and concludes the absence of sexagesimal system and all *'…ratios are binary or decimal.'*

Hemmy (1931) also observes the various possibilities of arriving at the weighing system based on the weight of grains such as wheat, barely, ratti. Hemmy (1931) finally concludes that the mean value of the most commonly occurring weight is of ratio 16 and weighs 13.71 gm at Mohenjo-daro. Hemmy (1943) later on the analysis of a large number of weights from

Harappa, Mohenjo-daro calculates the 'Mode', or value of maximum frequency to be 13.625 gm.

8.3.1 Analysis of Weights from Dholavira

The weights from Dholavira posed a problem of plenty in terms of form, material, quantity and above all a plethora of weight values Hemmy (1931: 589-98;1937-98:601-12), who identified, examined and analysed a huge amount of specimens from the excavation of Mohenjo-daro, Harappa and Chanhu-daro, made the task pretty easy by his pioneering work. He classified them into a wide range of forms running from perfect cubes to ordinary pebbles, with many other shapes in between. He also worked out that the system of weights comprising series of ratios among units was hexadecimal i.e. base sixteen, also called binary system in which values progress as 2, 4, 8, 16, is system which had been in use in India from very ancient through modern times until the introduction of the metric system by the Government of India. Hemmy also identified fractional as well as aberrant weights.

After examining about two thousand objects from Dholavira, 996 specimens were identified as weights and subjected to detailed examination; documentation and same were listed 8.3.3. Those included all such specimens, which have already been given specific designations by Hemmy. Apart from them, there remained many, which did not fit in any definition of an object, or use, or form. Those have been designated as amorphous. All of them were marks of modification by rubbing different sides so that those could conform to a unit of weight. Most interestingly, those were shell pieces as fragmented bangle or industrial waste, besides like pieces of stone made into weight by rubbing. Since all the weights were giving bafflingly continuous count of numerals in terms of weight value, first of all those were selected which were conforming to the unit weight of Hemmy's system. Before that upper & lower limits in case of each was calculated by allowing 5% deviation plus or mines of mean weight. Furthermore, there were found many weights, which were lesser in value than those listed, by Hemmy and other excavators.

In the process many missing links in the previous series also got filled up. This series was given designation A.

Many excavator sites have provided certain aberrant weights which were taken into a account an given assumed ratios against which the Dholavira weights were studies and arranged. In a separate list, designated B. it was also found that that series too was hexadecimal. All the remaining weight both the series were studies the fresh in view of the calculated lowest unit value. It was found that in both A and B, there were two subsidiary series which were rather decimal that is base ten. Thus have emerged two series in A, called A 1 and A 2, both related to each other, likewise B series was also subdivided. Both are given below with all relevant details, including the system of ratios in each. Apart from the typical cubical chert weights of the Harappan typology, several other shapes were also encountered from the Dholavira collection, which on analysis fell into on one of the weight series. The following is the nomenclature adopted for describing various shapes of the weights:

1.	Amorphous	Devoid of any definable shape, often squarish or rectangular in appearance. Can be equated with the kind of unusual shaped weights in the local markets and bazaars.
2.	Bar	With rectangular cross-section
3.	Barrel	Barrel shaped
4.	Bi-convex	Convex profile on both the sides
5.	Conical	Cone-shaped
6.	Cuboid	Cube shape with or without rounded edges
7.	Cylindroid	Cylindrical shape
8.	Discoid	Resembles a flat disc
9.	Domical	With a domical top

10.	Hemispheroid	Hemispherical shape
11.	Lentoid (beady)	Lenticular shape
12.	Ovate	Oval in shape
13.	Pebble	River pebbles flattened on one side for stability and in some cases chipping done to conform to the weighing system
14.	Plano-convex	Plano-convex in shape
15.	Prismatic	Prism shape
16.	Pyramidal	Shape of pyramid, with flat top and base
17.	Spheroid	Spherical in shape
18.	Tabloid	Tablet-shaped
19.	Trapezoidal	Trapezoid-shaped

Based on the above categories of shape analysis of the weights was carried out which can be seen in the following table:

Shape

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Amorphous	78	7.8	7.8	7.8
	Bar	13	1.3	1.3	9.1
	Barrel	14	1.4	1.4	10.5
	Bi-convex	2	.2	.2	10.7
	Conical	32	3.2	3.2	14.0
	Cuboid	393	39.5	39.5	53.4
	Cylindroid	91	9.1	9.1	62.6
	Discoid	89	8.9	8.9	71.5
	Domical	5	.5	.5	72.0
	Hemispheroid	6	.6	.6	72.6
	Lentoid (beady)	4	.4	.4	73.0
	Ovate	7	.7	.7	73.7
	Pebble	46	4.6	4.6	78.3
	Plano-convex	1	.1	.1	78.4
	Prismatic	2	.2	.2	78.6

	Pyramidal	13	1.3	1.3	79.9
	Spheroid	124	12.4	12.4	92.4
	Tabloid	74	7.4	7.4	99.8
	Trapezoidal	2	.2	.2	100.0
	Total	996	100.0	100.0	

A total of 996 weights were available for this analysis and the cuboid shape dominates the most with 393 (39.5%) followed by spheroid (124, 12.4%), cylindroid (91, 9.1%), discoid (89, 8.9%), amorphous (78, 7.8%), tabloid (74, 7.4%), amorphous (78, 7.8%), pebble (46, 4.6%), conical (32, 3.2%), bar (13, 1.3%), barrel (14, 1.4%), pyramidal (14, 1.4%) and other minor varieties which are represented in very small numbers. A comparatively large number of amorphous and pebble shaped weights indicate the adoption of weighing system and transferring it to whatever material available at the disposal. It may also be interpreted that these unusual shaped weights, a departure from the normal cubical Harappan weights, could have been used by a section of population who might not have access to sophisticated and well finished weights. However, it may be noted that these weights also fall into the standardised weight system. A pie chart on the distribution of weights based on the material is given below:

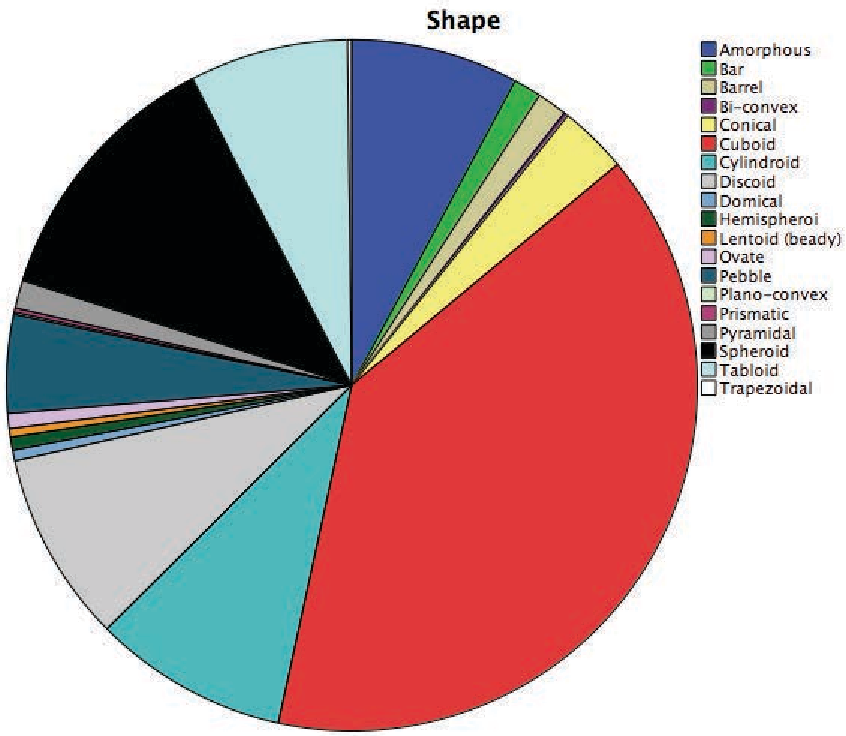


Fig. 8.33: Pie chart showing the classification of weights based on shape

The material-wise analysis of 994 weights from Dholavira has indicated that the most preferred or most number of weights is with shell as the manufacturing material, which constitutes 236 (23.8%) in number out of the total collection. This is followed by other materials like sandstone (148, 14.9%), chert (135, 13.6%), unidentified stone (98, 9.9%), agate (85, 8.6%), terracotta (73, 7.3%), limestone (50, 5%), basalt (29, 2.9%), jasper (26, 2.6%), black stone and copper (21 each, 2.1%). The other materials constitute a minor collection. The table showing the distribution of various materials is given below:

			Object			
			Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20.	Agate	85	8.6	8.6	8.6
	21.	Basalt	29	2.9	2.9	11.5
	22.	Basalt (olivine)	1	.1	.1	11.6
	23.	Black stone	21	2.1	2.1	13.7
	24.	Brown stone	1	.1	.1	13.8
	25.	Carnelian	5	.5	.5	14.3
	26.	Chalcedony	12	1.2	1.2	15.5
	27.	Chert	135	13.6	13.6	29.1
	28.	Cherty limestone	1	.1	.1	29.2
	29.	Copper	21	2.1	2.1	31.3
	30.	Ernestite	1	.1	.1	31.4
	31.	Gabbro	9	.9	.9	32.3
	32.	Green stone	1	.1	.1	32.4
	33.	Grey Limestone	4	.4	.4	32.8
	34.	Grey sandstone	1	.1	.1	32.9
	35.	Grey Stone	2	.2	.2	33.1
	36.	Hematite	1	.1	.1	33.2
	37.	Hornblende	1	.1	.1	33.3
	38.	Jasper	26	2.6	2.6	35.9
	39.	Limestone	50	5.0	5.0	40.9
	40.	Limy Sandstone	1	.1	.1	41.0
	41.	Olivine	1	.1	.1	41.1
	42.	Paste	1	.1	.1	41.2
	43.	Pottery	5	.5	.5	41.8
	44.	Quartz	3	.3	.3	42.1
	45.	Quartzite	1	.1	.1	42.2

	46.	Sandstone	148	14.9	14.9	57.0
	47.	Sandy limestone	2	.2	.2	57.2
	48.	Serpentine	2	.2	.2	57.4
	49.	Shell	237	23.8	23.8	81.3
	50.	Siltstone	5	.5	.5	81.8
	51.	Steatite	4	.4	.4	82.2
	52.	Stone	98	9.9	9.9	92.1
	53.	Terracotta	73	7.3	7.3	99.4
	54.	Vesuvianite	1	.1	.1	99.5
	55.	Yellow limestone	5	.5	.5	100.0
		Total	994	100.0	100.0	

It is interesting to note that a total of 55 materials have been exploited by the Harappans of Dholavira to manufacture the weights, and it is not surprising that shell dominate the entire collection as it could have been the most easily available material in this region due to the proximity of coastal line. The pie chart showing the material-wise distribution of weights is given below:

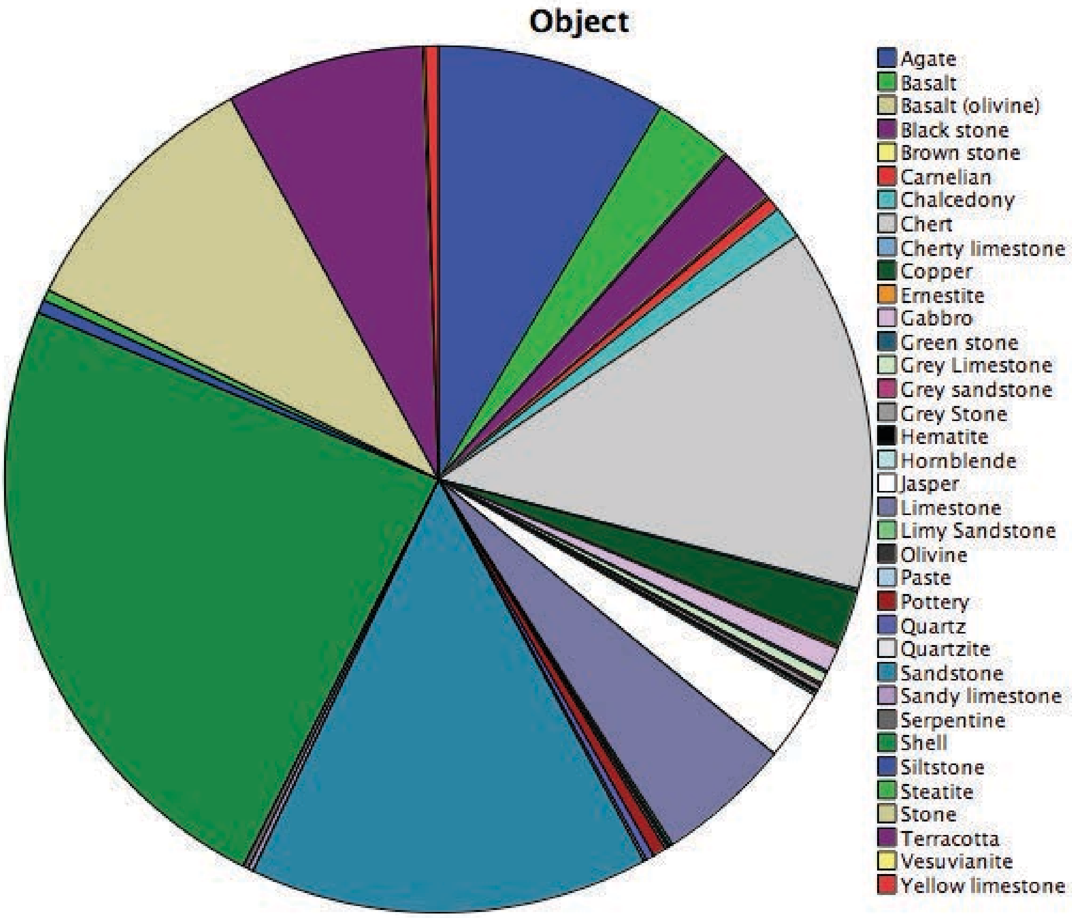


Fig. 8.34: Pie chart showing the classification of weights based on material

A total of 990 weights were available to determine the distribution based on their state. The result is shown in the following table:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Complete	579	58.5	58.5	58.5
	Complete, Modified	1	.1	.1	58.6
	Complete, Remodified	3	.3	.3	58.9
	Natural	5	.5	.5	59.4
	Non-classical	268	27.1	27.1	86.5
	Sub-classical	133	13.4	13.4	99.9
	Sub-classical, remodified	1	.1	.1	100.0
	Total	990	100.0	100.0	

The above table clearly shows that an overwhelming 579 weights (58.5%) are in complete state following by others represented by non-classical shapes (268, 27.1%) and sub-classical ones (133, 13.4%). The pie chart of the distribution is shown below:

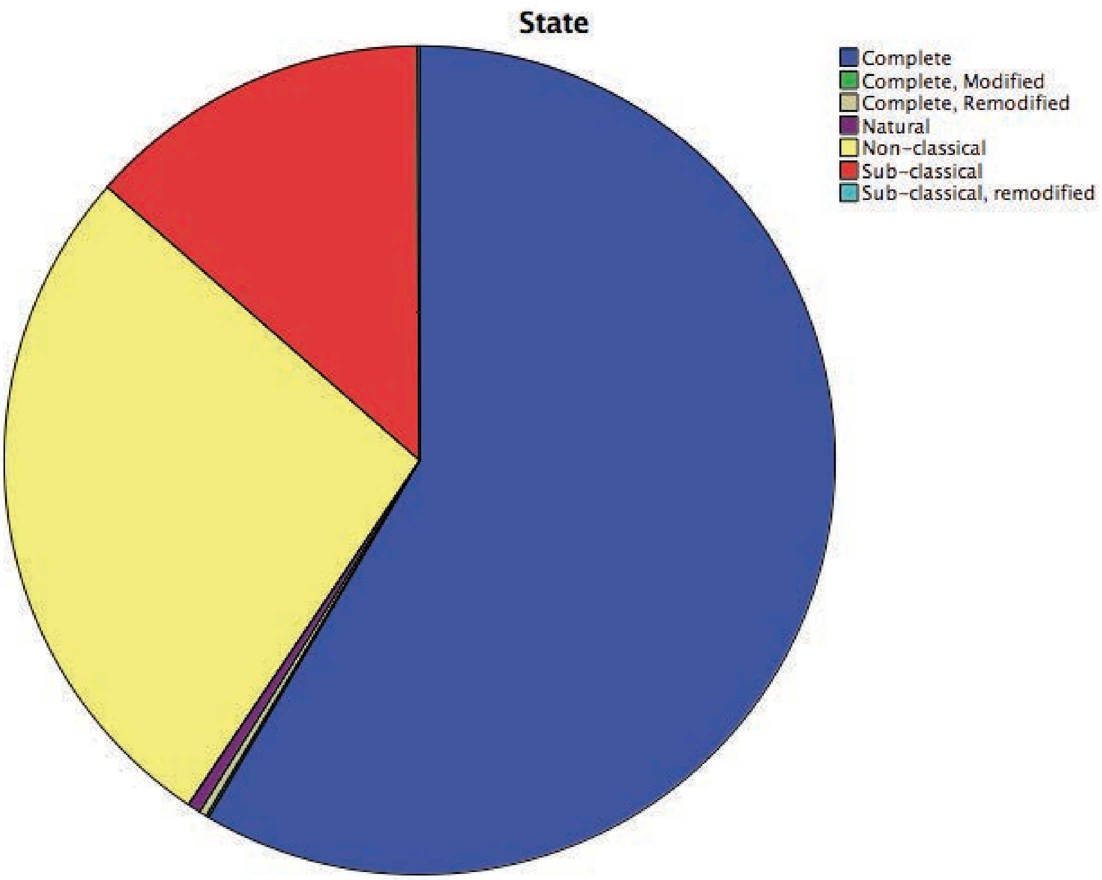


Fig. 8.35: Pie chart showing the classification of weights based on state

A total of 987 weights were available for analysis for determining the various preservation conditions. The result is shown in the following table:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Badly Chipped	3	.3	.3	.3
	Chipped	15	1.5	1.5	1.8
	Chipped, Calculable	7	.7	.7	2.5
	Corroded	1	.1	.1	2.6
	Damaged, Calculable	5	.5	.5	3.1
	Damaged, Omitted	56	5.7	5.7	8.8
	Modified	5	.5	.5	9.3
	Partly Chipped	7	.7	.7	10.0
	Patinated	2	.2	.2	10.2
	Perfect	673	68.2	68.2	78.4
	Perfect, damaged	1	.1	.1	78.5
	Slightly Chipped	203	20.6	20.6	99.1
	Slightly Chipped, cal.	1	.1	.1	99.2
	Slightly Corroded	4	.4	.4	99.6
	Tempered, Omitted	1	.1	.1	99.7
	Unfinished	3	.3	.3	100.0
	Total	987	100.0	100.0	

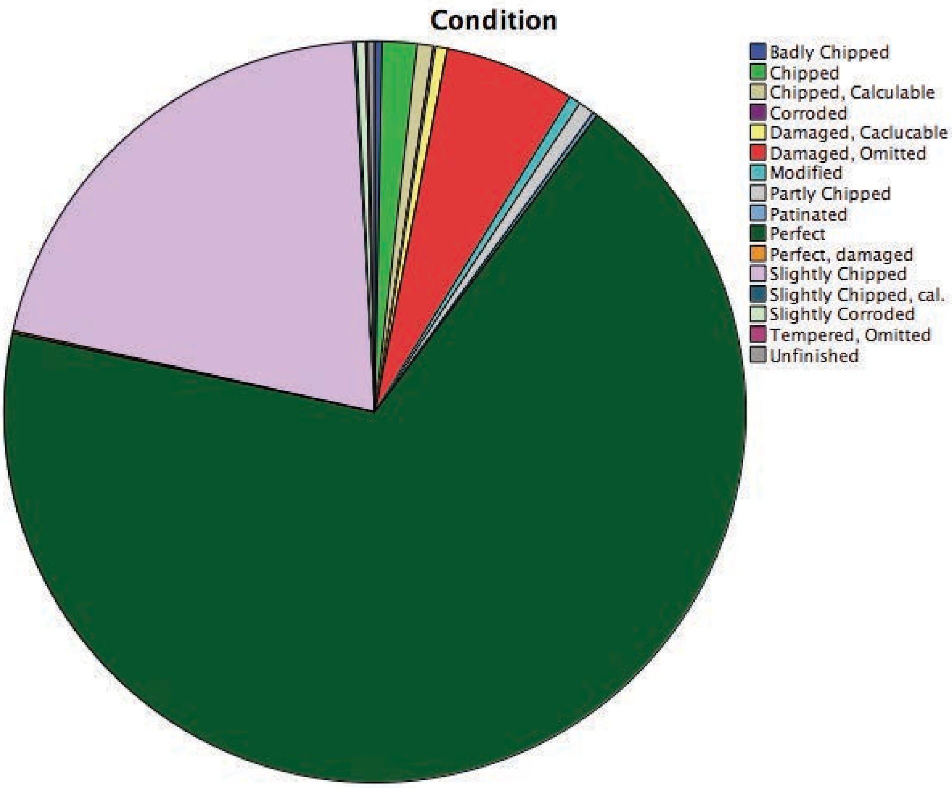


Fig. 8.36: Pie chart showing the classification of weights based on condition

The analysis indicates that an overwhelming number of 673 weights are in a perfect condition (68.2%) followed by slightly chipped (203, 20.6%), damaged, which were later omitted for weight analysis (56, 5.7%). The other varieties of condition are very few in number and this clearly shows the good state of preservation of the weights. The pie chart on the analysis is may be seen above.

A total of 615 weights were available for analysis to know the locality from which they were found. The analysis indicate that a majority of the weights come the Middle Town (278, 45.2%) followed by Castle (189, 30.7%), Lower Town (72, 11.7%), Bailey (43, 7%).

The remaining localities can be interpreted as secondary context. However the good number of weights near the eastern reservoir area may indicate the use of the peripheral area for some commercial purposes.

Locality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bailey	43	7.0	7.0	7.0
	Castle	189	30.7	30.7	37.7
	Cemetery	2	.3	.3	38.0
	East of Castle	2	.3	.3	38.4
	Embankment	5	.8	.8	39.2
	En Reservoir	14	2.3	2.3	41.5
	Lower Town	72	11.7	11.7	53.2
	Middle Town	278	45.2	45.2	98.4
	Open Area	1	.2	.2	98.5
	Sn Reservoir	2	.3	.3	98.9
	Sn Reservoir 3	2	.3	.3	99.2
	South of Castle	5	.8	.8	100.0
	Total	615	100.0	100.0	

The pie chart showing the distribution of weights as per the locality is shown below:

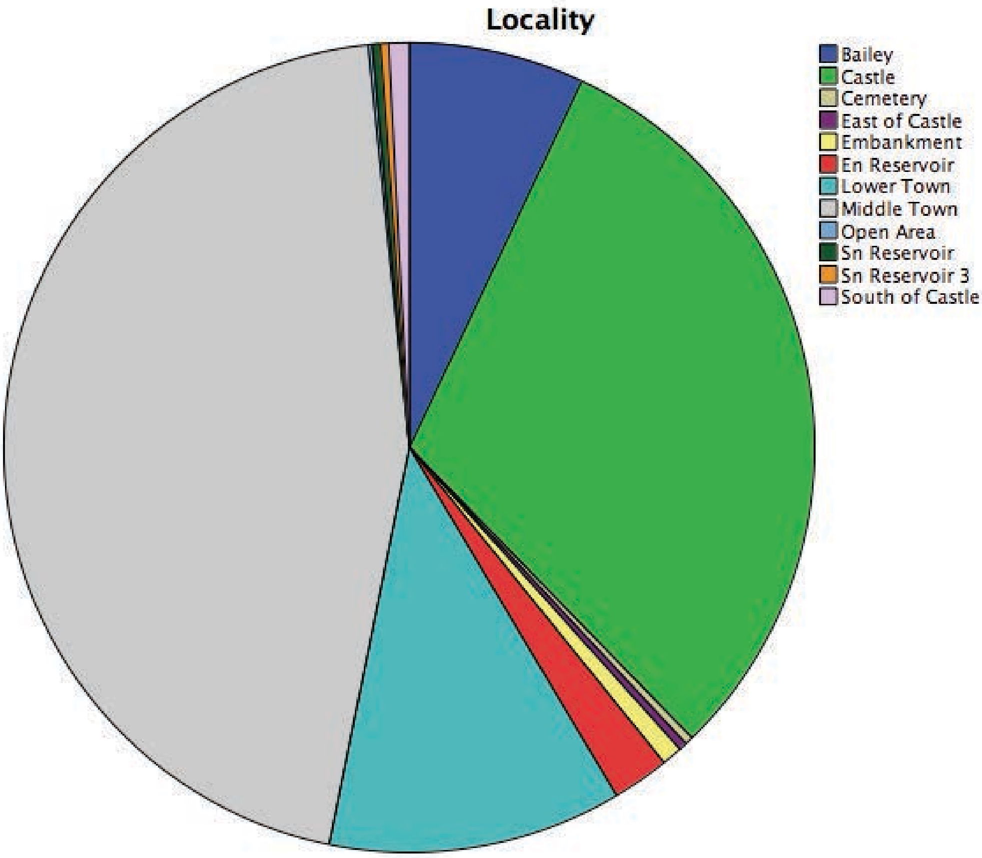


Fig. 8.37: Pie chart showing the classification of weights based on locality

A total of 470 weights were available for understanding their distribution based on the period / stage.

Period					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	III	2	.4	.4	.4
	IV	167	35.5	35.5	36.0
	IV/V	24	5.1	5.1	41.1
	IV/V/VI	4	.9	.9	41.9
	IV/VI	1	.2	.2	42.1
	V	183	38.9	38.9	81.1
	V/VI	11	2.3	2.3	83.4
	VI	78	16.6	16.6	100.0
	Total	470	100.0	100.0	

The analysis indicate that a majority of the weights, i.e. 183 (38.9%) come from Stage V followed by Stage IV (167, 35.5%), both of which correspond to the mature Harappan phase at Dholavira.

Thus, an overwhelming 74.4% of the weights are from this period, which is a clear indication of the commercial activities. Further, the more number of weights from Stage V is also an indication of peak in commercial activities during the later stages of the mature Harappan phase at Dholavira.

The weights from Stage VI numbers to 78 (16.6%), which is also a clear indication of the continuation of commercial activities during the late Harappan phase at Dholavira. This also conforms to the site distribution maps during the late Harappan phase, which clearly shows the continuity of sites after the demise of Harappan phase in Sindh and Punjab. The Gujarat region of the Harappan domain could have clearly continued the commercial initiatives of the Harappa phase.

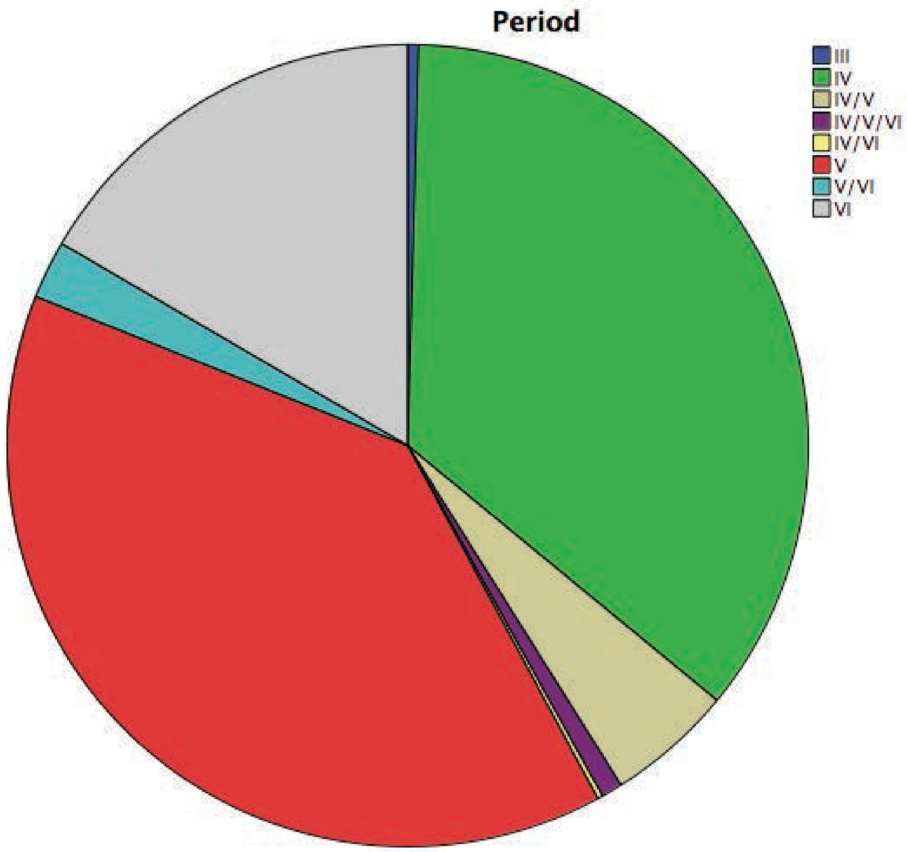


Fig. 8.38: Pie chart showing the classification of weights based on period



Fig. 8.39: Weights of banded Rohri chert, Dholavira



Fig. 8.40: Weights of banded Rohri Chert and Agate



Fig. 8.41: Cubical and Triangular weights



Fig. 8.42: Weights of banded Rohri Chert



Fig. 8.43: Weights of banded Rohri chert arranged from smaller to bigger



Fig. 8.44: Truncated spherical and cubical weights of chalcedony



Fig. 8.45: Weights of sandstone

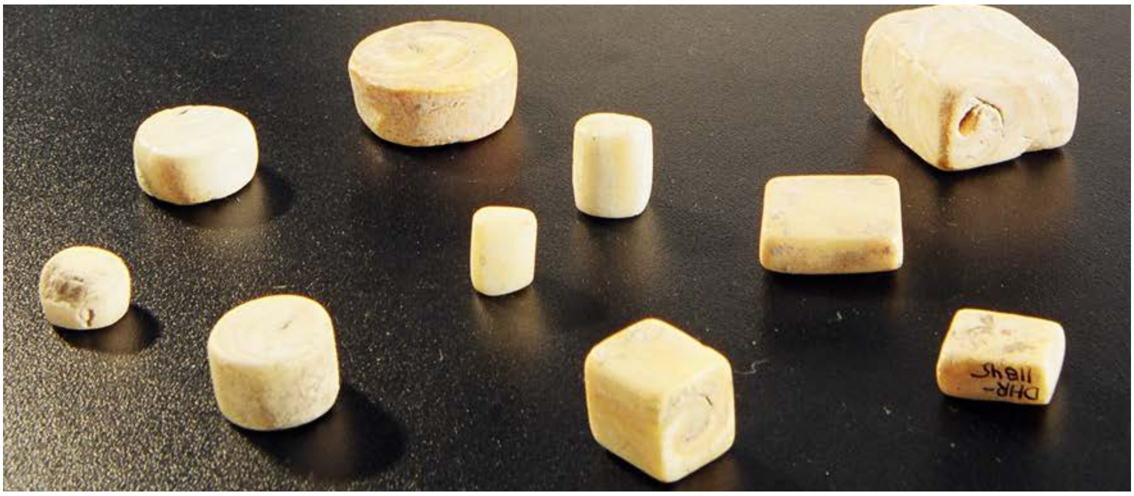


Fig. 8.46: Weights of shell and banded Rohri chert



Fig. 8.47: Weights of sandstone, banded Rohri chert and chalcedony



Fig. 8.48: Weights of various materials



Fig. 8.49: Cubical weights of various sizes



Fig. 8.50: Weights of shell arranged from lightest to heavier



Fig. 8.50: Shell and stone bar weights



Fig. 8.52: Weights of various shapes and sizes



Fig. 8.53: Copper weights



Fig. 8.54: Truncated spherical weights of limestone



Fig. 8.55: Cylindrical weights of Shell



Fig. 8.56: Disc weights of Terracotta



Fig. 8.57: Cubical weights of Terracotta



Fig. 8.58: Weights of Terracotta



Fig. 8.59: Weights of Terracotta



Fig. 8.60: Weights of Terracotta and Stone



Fig. 8.61: Weights of sandstone



Fig. 8.62: Larger weights of sandstone and limestone



Fig. 8.63: Truncated spherical weights of sandstone and limestone



Fig. 8.64: Weights of different shapes



Fig. 8.65: Cubical weights arranged from lighter to heavier



Fig. 8.66: Cubical weights arranged from lighter to heavier



Fig. 8.67: Shell weights arranged from lighter to heavier



Fig. 8.68: Shell weights arranged from lighter to heavier



Fig. 8.69: Example of larger weight



Fig. 8.70: Example of larger weight



Fig. 8.71: Example of larger weight



Fig. 8.72: Example of larger weight

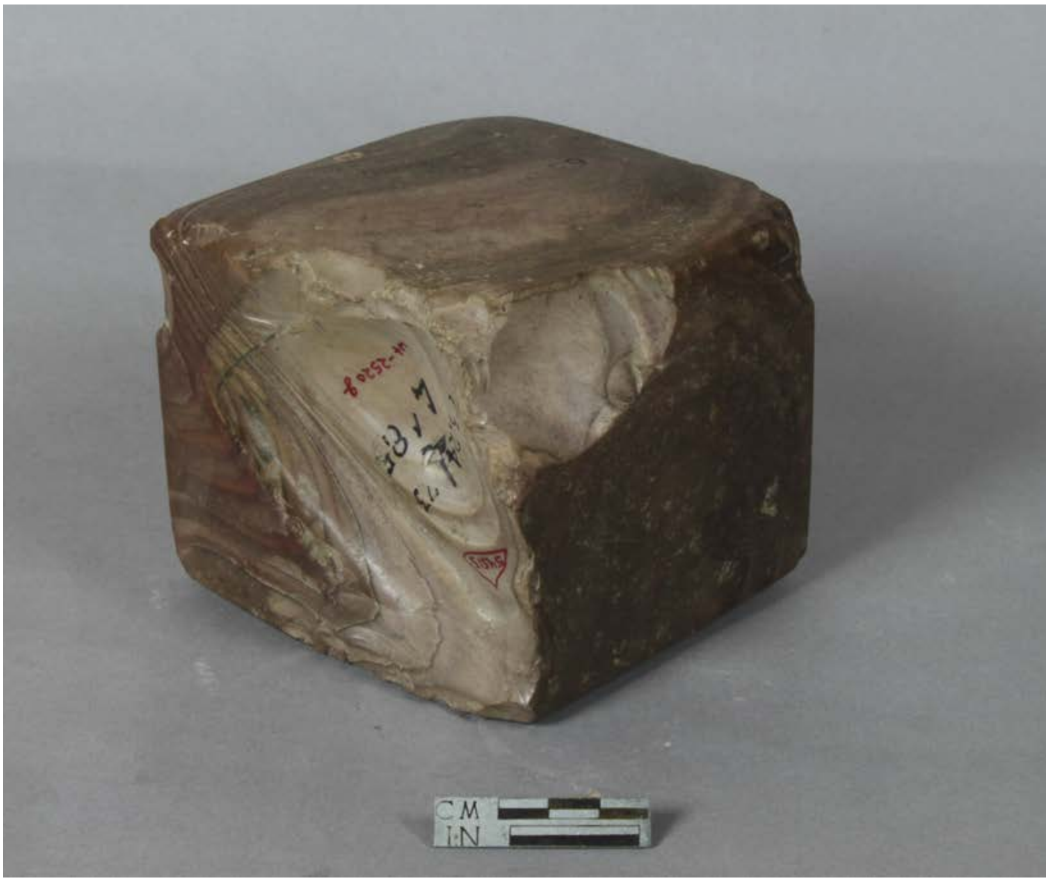


Fig. 8.73: Example of larger weight of Rohri chert

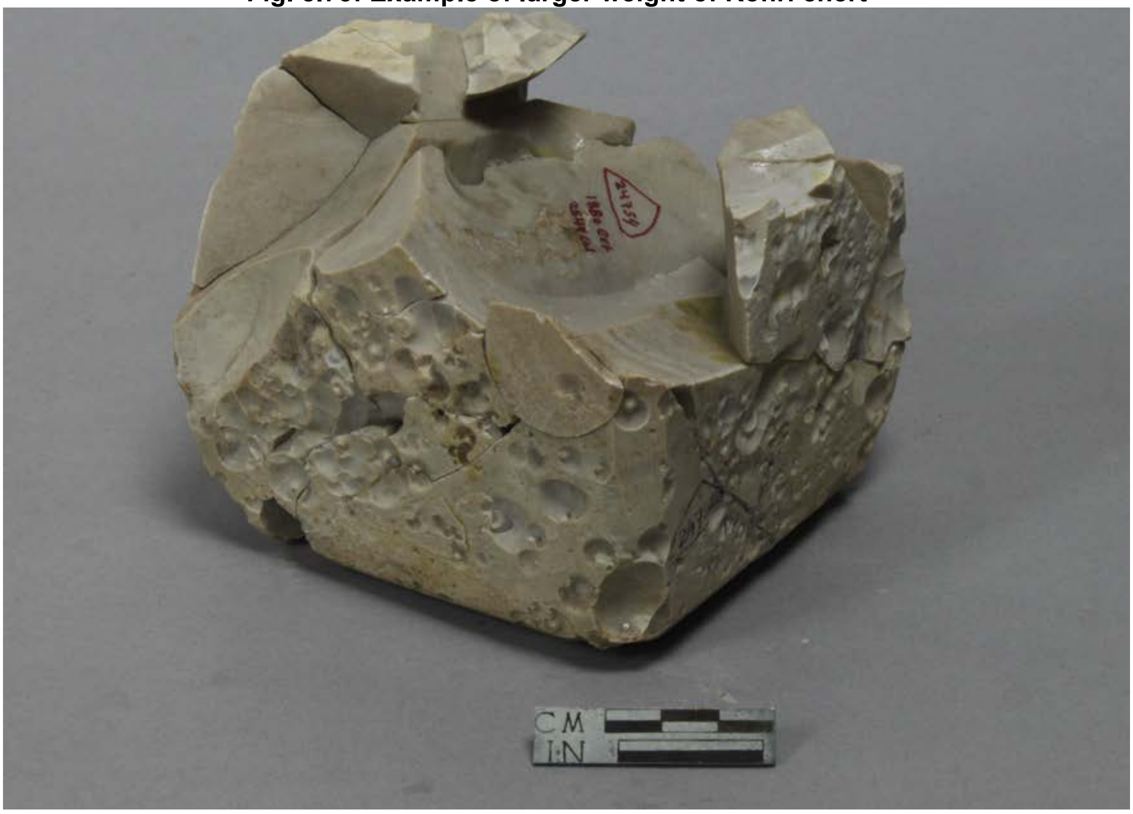


Fig. 8.74: Example of larger weight of Rohri chert



Fig. 8.75: Example of larger weight of limestone

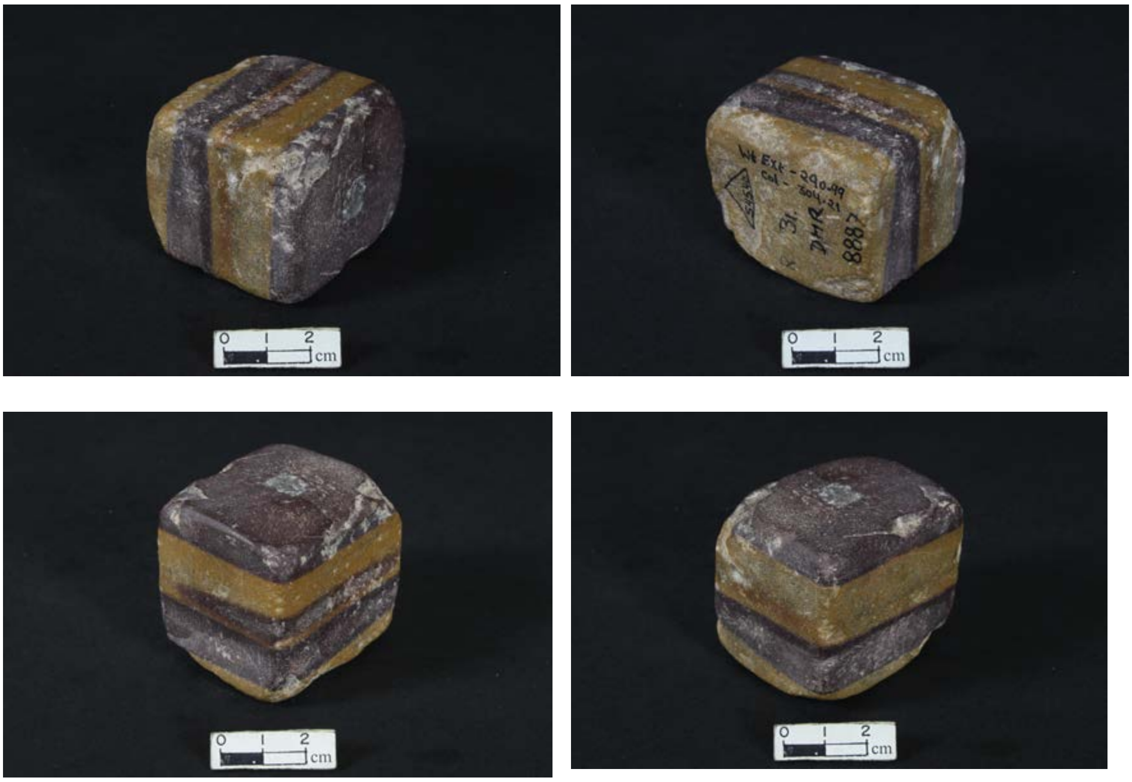


Fig. 8.76: Multiple views of banded limestone weights

The methodology of analysis of the Dholavira weights was carried out on the lines of analysis already done by A.S. Hemmy (1931, 1943) and it

indicates that two broad series can be delineated from the weights, each again have two sub-series. The results from the analysis are shown in the following tables with the series named as A-1, A-2, B-1 and B-2. The detailed catalogue of all the weights from Dholavira is shown below.

8.3.2 Dholavira Weight Series

Series A

Series A-1

1 Desig nation	2 No. of Spec.	3 Mean weight	5 Limits Lower	5 Limits Upper	6 Ratio	7 Calc. value	8 Diff. bet. Cols. (3)&(7)
i	1	0.083	0.083	-	0.1	0.0856	-0.002
ii	nil	-	-	-	0.125	0.107	-
iii	1	0.161	0.161	-	0.2	0.1712	-0.01
iv	nil	-	-	-	0.25	0.214	-
v	7	0.335	0.316	0.366	0.4	0.3424	0.121
vi	2	0.428	0.406	0.449	0.5	0.428	0
vii	21	0.690	0.656	0.722	0.8	0.6848	0.005
viii	39	0.855	0.807	0.898	1	0.856	-0.001
ix	14	1.359	1.302	1.436	1.6	1.370	-0.011
x	38	1.728	1.608	1.798	2	1.712	0.016
xi	14	2.745	2.600	2.861	3.2	2.74	0.005
xii	65	3.446	3.202	3.589	4	3.424	0.022
xiii	13	5.46	5.206	5.754	6.4	5.48	-0.02
xiv	47	6.859	6.522	7.185	8	6.848	0.011
xv	29	13.726	13.2	14.334	16	13.7	0.026

Series A-2

1 Desig nation	2 No. of Spec.	3 Mean weight	5 Limits Lower	5 Limits Upper	6 Ratio	7 Calc. value	8 Diff. b Cols. & (7
i	1	0.07	0.065	0.0714	0.0625	0.0685	0.00
ii	1	0.132	0.132	-	0.125	0.137	-0.00
iii	4	0.276	.264	0.284	0.25	0.274	0.002
iv	22	0.546	.510	0.577	0.5	0.548	-0.00
v	17	1.095	1.041	1.155	1	1.096	-0.00
vi	28	2.197	2.083	2.299	2	2.192	0.005
vii	20	4.342	4.11	4.6	4	4.384	-0.04
viii	11	8.571	8.013	9.1	8	8.768	-0.19
ix	5	10.991	10.548	11.418	10	10.96	0.03
x	14	17.237	16.299	18.255	16	17.536	-0.29
xi	5	21.591	20.884	22.395	20	21.92	-0.32
xii	6	34.718	33.718	36.869	32	35.072	-0.35
xiii	7	43.044	41.601	44.875	40	43.84	-0.79
xiv	2	70.567	70	71.133	64	70.144	**0.423**
xv	2	89.078	87.895	90.261	80	87.68	**1.398**

xxi	**8**	544.15	520.000	580.00	**640**	**548**	-3.85	**xxi**	**nil**	-	-	-	**640**	**701.44**	-
xxii	**nil**	-	-	-	**800**	**684.8**	-	**xxii**	**1**	830	-	830	**800**	**876.8**	-46.8
xxiii	**4**	1326.667	1300.00	1350.00	**1600**	**1370**	-43.33								
xxiv	**3**	2658	2544.00	2690.00	**3200**	**2740**	-82								
xxv	**1**	5690	5690	-	**6400**	**5480**	210								
xxvi	**nil**	-	-	-	**8000**	**6848**	-								
xxvii	**2**	13722.5	13720	13725	**16000**	**13700**	22.5								

Series B

Series B-1								Series B-2							
1 Desig nation	2 No. of Spec.	3 Mean weight	5 Limits Lower	Upper	6 Ratio	7 Calc. value	8 Diff. bet. Cols. (3) & (7)	1 Desig nation	2 No. of Spec.	3 Mean weight	5 Limits Lower	Upper	6 Ratio	7 Calc. value	8 Diff. bet. Cols. (3)&(7)
i	1	0.092	0.092	0.101	0.1	0.097	-0.005	i	nil	-	-	-	0.1	0.0776	-
ii	1	0.202	0.202		0.2	0.194	0.008	ii	nil	-	-	-	0.2	0.1552	-
iii	3	0.392	0.372	0.411	0.4	0.388	0.004	iii	3	0.296	0.294	0.300	0.4	.3104	-0.014
iv	21	0.771	0.736	0.801	0.8	0.776	-0.005	iv	8	0.630	0.606	0.647	0.8	.6208	0.01
v	27	0.972	0.924	1.018	1	0.97	0.002	v	21	0.771	0.736	0.801	1	0.776	-0.005
vi	44	1.93	1.84	2.032	2	1.94	-0.01	vi	14	1.517	1.47	1.584	2	1.552	-0.035
vii	24	3.847	3.682	4.047	4	3.88	-0.033	vii	16	3.069	2.944	3.151	4	3.104	-0.035
viii	6	4.856	4.655	5.028	5	4.85	0.006	viii	13	6.263	6.038	6.426	8	6.208	0.055
ix	12	7.606	7.387	7.837	8	7.76	-0.154	ix	10	12.342	11.702	12.758	16	12.416	-0.074
x	7	9.939	9.608	10.174	10	9.70	0.239	x	3	24.514	23.675	25.867	32	24.832	-0.318
xi	10	15.637	14.797	16.25	16	15.52	0.117	xi	5	49.825	47.181	52.147	64	49.664	0.161
xii	7	19.395	18.544	20.355	20	19.40	-0.005	xii	4	121.117	117.603	125.996	160	124.16	-3.043
xiii	7	30.072	29.48	30.787	32	31.04	-0.968	xiii	5	247.236	238.153	250	320	248.32	-1.084
xiv	3	38.642	36.869	39.591	40	38.80	-0.158	xiv	2	490	471.808	521.472	640	496.64	-6.64
xv	8	42.836	41.374	44.875	50	42.8	0.036	xv	1	610.000	589.76	651.84	800	620.8	-10.8
xvi	5	60.972	59.033	62.676	64	62.08	-1.108	xvi	1	1300	1179.520	1303.68	1600	1241.6	58.4
xvii	3	77.995	77.7	78.17	80	77.60	0.395	xvii	nil	-	-	-	3200	2483.2	-
xviii	3	98.58	96.201	100	100	97.00	1.58	xviii	1	4830	-	4830	6400	4966.4	-136.4
xix	1	155.879	155.879	-	160	155.2	0.68	xix	1	6360	5897.6	6518.4	8000	6208	152
xx	2	197.827	185.44	203.55	200	194.0	3.83	xx	2	12460	12070	12850	16000	12416	54
xxi	7	306.631	295.41	306.631	320	310.4	-3.77								

xxii	**7**	399.898	390.818	410.00	**400**	**388.0**	11.9
xxiii	**3**	436.667	420.000	450.00	**500**	**428**	8.667
xxiv	**1**	610.000	589.76	651.84	**640**	**620.8**	-41.84
xxiv	**1**	770	737.200	814.8	**800**	**776.0**	-6
xxv	**nil**	nil	-	-	**1000**	**970.0**	970
xxvi	**nil**	-	-	-	**1600**	**1552**	-
xxvii	**nil**	nil	-	-	**2000**	**1940**	-
xxviii	**nil**	3060	2948.8	3259.2	**3200**		
xxix	**2**	3955	3860	4050	**4000**	**3880**	75
xxx	**1**	6360	5897.6	6518.4	**6400**	**6208**	152

8.3.3 DETAILED CATALOGUE OF WEIGHTS OF ALL CATEGORIES FROM DHOLAVIRA EXCAVATION

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
1.	54406	Cubical	Complete	Badly Chipped	Sandstone	4590.000	18.40	9.00	-					
2.	54407	Cubical	Complete	Badly Chipped	Sandstone	6360.000	20.20	10.70	-					
3.	47175	Cuboid	Complete	Badly Chipped	heavily eroded	24.000	24.52	23.60	17.85	47x84x4	5	125		V
4.	53625	Cuboid	Complete	Chipped	Black stone	27.063	23.39	23.18	21.61	47x62x4	7	230	MIDDLE TOWN	IV
5.	39129	Cuboid	Complete	Chipped	Chert	27.640	25.89	24.41	18.83	45 13 x 3		Baulk	MIDDLE TOWN	
6.	1703	Cuboid	Complete	Chipped	Stone	27.794	27.96	26.92	16.24	XK 19/4	1	15		
7.	34170	Cuboid	Complete	Chipped	Chert	53.846	32.07	31.75	22.52	47 x 85 x 1	1	19	CASTLE	VI
8.	46416	Cuboid	Complete	Chipped	Chert	55.061	34.74	30.07	24.66	55 x 79 x 2	3	55	MIDDLE TOWN	IV
9.	26231	Spheroid	Complete	Chipped	Limestone	14.334	21.09	19.35	19.47	37x45x4	3	350	ER	IV/V
10.	7451	Tabloid	Complete	Chipped	Stone	30.424	35.44	35.32	14.95	47x62x1	2			
11.	54400	Amorphous	Complete	Chipped, Calculable	Limestone	4550.000	16.50	8.70	-	48x72xR-3N	1	+10 - +5	CASTLE	VI
12.	33518	Cuboid	Complete	Chipped, Calculable	Stone	248.025	60.93	45.93	38.36	48x38x1+2	17	820		
13.	52493	Cubical	Complete	Corroded	Copper	2.379	10.88	10.68	10.03	47 x 84 x 1	R 2	240	CITADAL	
14.	21595	Cuboid	Complete	Damaged, Caclucable	Chert	18.255	23.40	23.38	20.08	57 x 57 x 2	15 a	393	BAILEY	IV
15.	20989	Cuboid	Complete	Damaged, Caclucable	Chert	51.864	31.51	30.65	23.52	45 x 43 x 1	8	127	MIDDLE TOWN	IV
16.	37805	Cuboid	Complete	Damaged, Caclucable	Chert	53.919	31.52	30.95	23.77	47 x 75 x 1	3	65	CASTLE	VI
17.	54513	Cuboid	Complete	Damaged, Caclucable	Chert	2626.000	11.00	10.80	9.50					
18.	24754	Cuboid	Complete	Damaged, Caclucable	Chert	2544	111.94	107.41	92.20	35x84	1	10	MIDDLE TOWN	
19.	48220	Cubical	Complete	Damaged, Omitted	Agate	2.644	12.62	11.65	9.21	35 x 22 x 1	1	17	LOWER TOWN	V
20.	37881	Cuboid	Complete	Damaged, Omitted	Carnelian	0.385	6.67	6.50	4.41	45x3x3	13	315	MIDDLE TOWN	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
21.	27255	Cuboid	Complete	Damaged, Omitted	Agate	0.391	7.43	7.15	-	48 x 24	surfac e	surface	CASTLE	III
22.	15244	Cuboid	Complete	Damaged, Omitted	Chert	0.845	-	-	8.33	55 x 55 x 2	2	6-21	MIDDLE TOWN	IV
23.	3922	Cuboid	Complete	Damaged, Omitted	Chert	1.045	8.79	8.23	4.83	XR 19/1	2	30-40		
24.	1475	Cuboid	Complete	Damaged, Omitted	Basalt	2.455	10.25	10.16	9.81	XF 21/1	surfac e		CASTLE	VI
25.	1500	Cuboid	Complete	Damaged, Omitted	Chert	2.557	-	12.84	8.99	XK.19/4	1	20	BAILEY	V/VI
26.	20189	Cuboid	Complete	Damaged, Omitted	Chert	3.241	16.50	11.42	9.13	47x98x2	2	118		
27.	52797	Cuboid	Complete	Damaged, Omitted	Agate	4.332	15.03	13.51	11.80	55x96x1	2	50	MIDDLE TOWN	
28.	54471	Cuboid	Complete	Damaged, Omitted	Jasper	6.407	13.98	13.65	13.62	54x74x1	4	78	MIDDLE TOWN	IV
29.	37249	Cuboid	Complete	Damaged, Omitted	Chert	7.056	20.33	13.77	12.58	45x73x4	3	66	MIDDLE TOWN	V
30.	3504	Cuboid	Complete	Damaged, Omitted	Chert	8.170	16.21	15.88	14.54	A.13/4	8	300 - 40	CASTLE	IV
31.	8823	Cuboid	Complete	Damaged, Omitted	Chert	9.190	-	19.98	14.34	35 x 54 x1+4	3	25 - 50	LOWER TOWN	V
32.	10382	Cuboid	Complete	Damaged, Omitted	Chert	9.661	26.36	19.93	14.86	45x84	10	140	MIDDLE TOWN	IV
33.	23325	Cuboid	Complete	Damaged, Omitted	Agate	12.148	-	24.33	20.14	57 x 57 x 2	29	515	BAILEY	IV
34.	18678	Cuboid	Complete	Damaged, Omitted	Limestone	13.538	20.91	20.82	17.16	58 x51 x2	IA	85	B	MIX
35.	38770	Cuboid	Complete	Damaged, Omitted	Sandstone	16.557	24.14	22.85	20.53	46x71x1	3	135	MIDDLE TOWN	
36.	34372	Cuboid	Complete	Damaged, Omitted	Shell	22.400	25.43	25.20	18.00					
37.	24254	Cuboid	Complete	Damaged, Omitted	Stone	23.710	-	-	-	58x52x2	2		BAILEY	V
38.	54491	Cuboid	Complete	Damaged, Omitted	Limestone	810.000	103.2 2	100.4 8	38.42	b.19/1	1	surface	CASTLE	VI

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
39.	43192	Cuboid	Complete	Modified	Chert	4.409	13.93	13.52	9.94	47x95x1	2	45	CASTLE	
40.	11566	Cuboid	Complete	Modified	Stone	7.025	18.01	16.25	15.95	45x54x4	2a	22-50		
41.	35857	Amorphous	Complete	Perfect	Shell	0.736	8.23	-	6.07	46x54x3	1	17		
42.	20479	Amorphous	Complete	Perfect	Shell	0.756	7.02	-	7.77	58x53x3	8	205		
43.	20969	Amorphous	Complete	Perfect	Shell	0.756	7.52	-	6.95	58x52x2	6	190		
44.	46642	Amorphous	Complete	Perfect	Shell	0.786	7.96		7.00	47x75x4	6	243	CASTLE	
45.	20964	Amorphous	Complete	Perfect	Shell	0.786	7.50	-	7.70	58x54x4+58x54x3	erosion	235		
46.	48412	Amorphous	Complete	Perfect	Shell	0.833	7.14	-	7.76	surface	surface			
47.	38351	Amorphous	Complete	Perfect	Shell	0.854	9.39	7.49	5.57	55 x 82 x 1	2	11	MIDDLE TOWN	IV
48.	18586	Amorphous	Complete	Perfect	Shell	0.957	11.67	11.17	4.58	45x33x3	3	31		
49.	54512	Amorphous	Complete	Perfect	Shell	1.118	14.83	8.68	4.75	55x83x2	3	55-66		
50.	691	Bar	Complete	Perfect	Shell	1.657	15.24	7.94	5.66	xj-19/1+4	surface			
51.	49845	Bar	Complete	Perfect	Shell	1.755	2.80	0.70	0.30	47x74x4	6	-166		
52.	50354	Barrel	Complete	Perfect	Agate	0.547	-	5.40	0.40	47 x 84 x 4	5	161	CASTLE	
53.	43021	Barrel	Complete	Perfect	Agate	0.744	9.43	7.13	-	55 x 78 x 1	2	59	MIDDLE TOWN	IV
54.	16740	Barrel	Complete	Perfect	Agate	1.862	8.70	12.58	-	55 x x57 x 3	6	128	MIDDLE TOWN	IV
55.	52420	Barrel	Complete	Perfect	Agate	2.128	10.96	12.94	-	47x73x3	25	500	CITADAL	
56.	41734	Barrel	Complete	Perfect	Agate	2.264	10.20	13.75	-	55 x x86 x 3	2	27	MIDDLE TOWN	IV
57.	40545	Barrel	Complete	Perfect	Chalcedony	2.651	10.52	14.66	-	28 x 96 x 1	1	5		
58.	40506	Barrel	Complete	Perfect	Agate	5.530	13.67	14.86	-	55x86x1	3	50	MIDDLE TOWN	IV
59.	4609	Barrel	Complete	Perfect	Agate	6.426	14.08	19.01	-	XA 19/1	2	30		
60.	45029	Barrel	Complete	Perfect	Jasper	29.267	21.00	39.40	-	55x87x4	3	66	MIDDLE TOWN	IV
61.	54477	Bi-convex	Complete	Perfect	Chalcedony	8.368	23.64	22.29	10.61	47x9x3	unstratified	118	CASTLE	V
62.	29023	Bi-convex	Complete	Perfect	Sandstone	10.548	25.45	24.30	10.75	37 x 44 x 2	2	45	ER	VI
63.	4160	Conical	Complete	Perfect	Black stone	0.668	5.31	4.46	11.88	XF 23/2	10			
64.	54501	Conical	Complete	Perfect	Chert	0.671	6.21	5.19	19.45	57x16x1	4	80		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
65.	16768	Conical	Complete	Perfect	Jasper	0.814	10.38	6.70	-	55x51x1	2	20	MIDDLE TOWN	IV
66.	13373	Conical	Complete	Perfect	Black stone	0.845	7.38	4.40	12.08	15x54x3	2	10		
67.	13473	Conical	Complete	Perfect	Black stone	0.856	7.88	6.13	8.26	15x24x1	2	17		
68.	3753	Conical	Complete	Perfect	Black stone	0.896	5.20	4.41	17.06	XC-19/1	3	60-80		
69.	23800	Conical	Complete	Perfect	Black stone	0.956	6.66	4.53	15.11	24x5x4	3	6		
70.	14374	Conical	Complete	Perfect	Black stone	0.957	6.44	5.14	13.34	65x64x1	7	140		
71.	44610	Conical	Complete	Perfect	Jasper	1.028	13.80	6.86	-	55x78xBaulk	2	10		
72.	21287	Conical	Complete	Perfect	Black stone	1.070	5.95	5.30	13.14	58x62x4	1	115		
73.	13850	Conical	Complete	Perfect	Stone	1.078	7.45	6.05	13.45	95x42x3	2	90		
74.	4742	Conical	Complete	Perfect	Stone	1.327	7.82	6.38	16.44	48x72	1	24-10		
75.	4472	Conical	Complete	Perfect	Black stone	1.352	6.70	5.45	15.65	A.17/1	14+1 5	300		
76.	4423	Conical	Complete	Perfect	Black stone	1.353	6.24	7.33	14.05	A 17/1	10	200-220		
77.	23999	Conical	Complete	Perfect	Black stone	1.361	8.70	5.67	9.92	47x27x2	5	118		
78.	8216	Conical	Complete	Perfect	Black stone	1.361	8.52	5.64	13.04	35x44x4	23	305-312		
79.	42386	Conical	Complete	Perfect	Jasper	2.976	9.60	18.20	-	55x85x4	3	74	MIDDLE TOWN	IV
80.	3622	Conical	Complete	Perfect	Grey stibe	3.345	11.76	6.60	17.62	OCE.22.1	21	341-356		
81.	39070	Conical	Complete	Perfect	Yellow limestone	3.739	11.39	8.47	20.43	35 x 73 & 35 x 83	baulk	44		
82.	24579	Conical	Complete	Perfect	Black stone	3.767	16.14	6.96	24.13	24x10x2+3	3			
83.	11704	Conical	Complete	Perfect	Jasper	4.296	12.19	11.51	14.62	47 x 6 x 4	3	53	MIDDLE TOWN	
84.	3215	Conical	Complete	Perfect	Terracotta	4.429	16.11	15.81	13.82	48 x 09 x1	8	393	CASTLE	
85.	38411	Conical	Complete	Perfect	Jasper	5.628	11.85	7.65	25.65	37 x 46 x1	19	750		
86.	53503	Cubical	Complete	Perfect	Jasper	14.160	17.00	16.30	13.00				ER	V/VI
87.	43191	Cubical	Complete	Perfect	Limestone	27.228	25.25	24.87	18.30	55x78x1	2	48	MIDDLE TOWN	IV
88.	13498	Cuboid	Complete	Perfect	Chert	0.264	4.98	4.98	5.11	15 x 74 x 3	1	10	MIDDLE TOWN	V
89.	54549	Cuboid	Complete	Perfect	Shell	0.275	5.56	5.41	3.74	35x22x2	1	6	LOWER TOWN	
90.	11468	Cuboid	Complete	Perfect	Shell	0.295	5.30	5.29	4.10	55 x 64 x 1	3	27	MIDDLE TOWN	IV
91.	11409	Cuboid	Complete	Perfect	Shell	0.300	6.80	6.44	2.79	47x15	6	143		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
92.	20441	Cuboid	Complete	Perfect	Shell	0.322	5.77	5.65	3.76	45 x43 x 2	9	143	MIDDLE TOWN	V
93.	19910	Cuboid	Complete	Perfect	Shell	0.360	6.06	5.99	4.06	25 x 63 x 3	1	20	LOWER TOWN	V
94.	48684	Cuboid	Complete	Perfect	Agate	0.366	6.77	6.57	4.70	47 x 84 x 1	5	130	CASTLE	V
95.	3673	Cuboid	Complete	Perfect	Agate	0.445	6.74	6.67	4.78	XE 23/1	MBR 1 B	Lower courses	LOWER TOWN	V
96.	18300	Cuboid	Complete	Perfect	Chert	0.484	6.43	6.10	5.67	57 x 54x2	1	28	MIDDLE TOWN	V
97.	7098	Cuboid	Complete	Perfect	Shell	0.517	7.55	6.76	4.98	35 x 64 x 4	humu s		MIDDLE TOWN	V
98.	39354	Cuboid	Complete	Perfect	Agate	0.525	6.47	6.41	5.39	35 x 83 x 1 + 2	2	85	MIDDLE TOWN	V
99.	20005	Cuboid	Complete	Perfect	Shell	0.550	7.87	7.03	4.14	45 x 42 x 2	6	83-87	MIDDLE TOWN	
100.	54556	Cuboid	Complete	Perfect	Shell	0.557	7.98	7.38	4.84	XE.22				
101.	35179	Cuboid	Complete	Perfect	Shell	0.577	7.59	7.46	4.67	35 x 63 x 1	pit	49	MIDDLE TOWN	
102.	2586	Cuboid	Complete	Perfect	Copper	0.579	6.37	6.00	5.16	zc 7 qd 3	3	35	CASTLE	VI
103.	18015	Cuboid	Complete	Perfect	Chert	0.617	8.22	6.21	5.13	surface			MIDDLE TOWN	
104.	40955	Cuboid	Complete	Perfect	Copper	0.646	7.26	7.15	4.08	55 x 85 x 2	2	63	MIDDLE TOWN	IV
105.	36223	Cuboid	Complete	Perfect	Shell	0.647	8.41	8.21	3.71	35x63x2	surfac e	200-05	MIDDLE TOWN	
106.	15293 a	Cuboid	Complete	Perfect	Copper	0.686	8.03	7.66	3.90	48 x 42 x 4	1	24	CASTLE	VI
107.	37241	Cuboid	Complete	Perfect	Chert	0.706	7.43	6.89	5.99	45 x 63 x 3	2	25	MIDDLE TOWN	V
108.	2352	Cuboid	Complete	Perfect	Terracotta	0.722	8.58	8.26	6.82	A 6	4	86	MIDDLE TOWN	V
109.	49971	Cuboid	Complete	Perfect	Agate	0.763	7.21	6.98	6.27	surface			LOWER TOWN	
110.	43189	Cuboid	Complete	Perfect	Terracotta	0.763	7.54	7.53	6.47	28 x 95 x 2	1	10	EMB. AREA	V/VI
111.	52092	Cuboid	Complete	Perfect	Copper	0.775	7.84	7.09	4.61	35 x 32 x 2	2	15-25	LOWER TOWN	V
112.	5064	Cuboid	Complete	Perfect	Chert	0.808	8.04	7.85	6.12	48x92x1+2	24		CASTLE	IV
113.	25641	Cuboid	Complete	Perfect	Chert	0.833	8.19	7.57	6.65		surfac e	surface		
114.	14993	Cuboid	Complete	Perfect	Basalt	0.856	7.79	7.55	3.85	47x 50 x 4	1	45	CASTLE	VI
115.	25296	Cuboid	Complete	Perfect	Chert	0.856	7.84	7.20	6.70	23 x 10 x 2	pit s/b 2	95	LOWER TOWN	IV

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
116.	9729	Cuboid	Complete	Perfect	Copper	0.856	7.36	6.86	5.37	25 x 64 x 2	3	45		
117.	3665	Cuboid	Complete	Perfect	Terracotta	0.879	8.59	8.53	6.91					
118.	38008	Cuboid	Complete	Perfect	Copper	0.893	6.24	6.16	7.21	45 x 73 x 1	3	33	MIDDLE TOWN	V
119.	49880	Cuboid	Complete	Perfect	Chalcedony	0.900	8.24	8.07	6.64					
120.	49049	Cuboid	Complete	Perfect	Chert	0.900	7.88	7.69	6.97	37x76x3	surface		En.Reser.area	
121.	4279	Cuboid	Complete	Perfect	Copper	0.902	8.02	6.89	4.80	XG19 Qd.2	1	130		
122.	4408	Cuboid	Complete	Perfect	Shell	0.906	9.00	8.24	5.09	A17/1	8	160-75		
123.	3915	Cuboid	Complete	Perfect	Shell	0.926	8.98	8.08	5.19	ZF 7/3	2	2		
124.	12579	Cuboid	Complete	Perfect	Shell painted	0.930	10.03	8.69	4.32	55x94	3	40		
125.	52132	Cuboid	Complete	Perfect	Agate	0.942	8.57	8.56	5.76	35x32x2	2	15-25	LOWER TOWN	V
126.	25137	Cuboid	Complete	Perfect	Chert	0.971	8.28	7.54	6.95	24 x 1 x 4	3	50	LOWER TOWN	V
127.	1247	Cuboid	Complete	Perfect	Chert	0.974	8.44	8.04	6.71	45x74x2	10	140	CASTLE	V
128.	25380	Cuboid	Complete	Perfect	Chert	0.997	8.09	7.94	6.65	26 x 4 x 4	3	222	LOWER TOWN	IV
129.	19015	Cuboid	Complete	Perfect	Chalcedony	0.998	7.99	7.50	6.92	57 x 60 x 2	3	110	BAILEY	V
130.	17774	Cuboid	Complete	Perfect	Shell	1.012	10.61	8.99	4.68	56x51x2	18	535		
131.	33764	Cuboid	Complete	Perfect	Shell	1.025	9.10	8.30	6.05	35 x 63 x 4	3	10	MIDDLE TOWN	V
132.	43188	Cuboid	Complete	Perfect	Chert	1.048	7.65	7.02	8.33	45x70x2	1	100	MIDDLE TOWN	
133.	19359	Cuboid	Complete	Perfect	Agate	1.080	9.19	8.06	6.44	58 x 52x 1	7	86	BAILEY	V
134.	24976	Cuboid	Complete	Perfect	Agate	1.098	8.47	8.43	7.38	47 x 88 x 2	unstratified		CASTLE	
135.	2423	Cuboid	Complete	Perfect	Shell	1.153	8.98	8.63	6.11	XE.22/2	G		CASTLE	
136.	31843	Cuboid	Complete	Perfect	Shell	1.170	9.00	8.39	6.40	55x33x1&2	2	37	MIDDLE TOWN	
137.	52762	Cuboid	Complete	Perfect	Agate	1.206	8.66	8.50	7.26		5	175	MIDDLE TOWN	V
138.	12914	Cuboid	Complete	Perfect	Chert	1.225	8.05	7.97	7.86	25 x 64	3	30	MIDDLE TOWN	IV
139.	29927	Cuboid	Complete	Perfect	Chert	1.310	9.00	8.89	5.32	57 x 7 x 1 + 4	2+3	70-80	CASTLE	V
140.	23727	Cuboid	Complete	Perfect	Paste	1.482	8.70	8.48	6.35	24 x 3 x 3	1	9	MIDDLE TOWN	IV/V
141.	11458	Cuboid	Complete	Perfect	Shell	1.584	8.93	8.80	7.72	47 x 96 x 3	5	135	CASTLE	VI

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
142.	16281	Cuboid	Complete	Perfect	Jasper	1.608	9.54	9.51	6.56	55x51x1	1	54		
143.	43182	Cuboid	Complete	Perfect	Chert	1.673	9.33	9.08	8.42	45 x 71 x 4	1	90	MIDDLE TOWN	V
144.	27940	Cuboid	Complete	Perfect	Chert	1.686	9.62	9.56	7.70	55 x 13 x 4	3	53	MIDDLE TOWN	IV
145.	35008	Cuboid	Complete	Perfect	Basalt	1.700	9.70	9.34	6.96	35x63x2	pit 1	28		
146.	9925	Cuboid	Complete	Perfect	Black stone	1.723	8.53	8.31	6.30	46 x 43	2	140	MIDDLE TOWN	V
147.	13664	Cuboid	Complete	Perfect	Shell	1.725	10.28	9.96	6.48	15 x 24 x 3	2	4		V
148.	29100	Cuboid	Complete	Perfect	Sandstone	1.727	10.24	9.47	8.90	55 x 23 x 3	2	31	MIDDLE TOWN	IV
149.	48174	Cuboid	Complete	Perfect	Chert	1.728	9.72	9.47	8.50	47 x 66	surfac e		MIDDLE TOWN	
150.	10615	Cuboid	Complete	Perfect	Chert	1.731	9.43	9.20	8.38	45 x 84	11	160	LOWER TOWN	IV
151.	40000	Cuboid	Complete	Perfect	Chert	1.733	10.10	9.51	8.43	35 x 83 x1 + 2	4	225-239	MIDDLE TOWN	IV
152.	9939	Cuboid	Complete	Perfect	Chert	1.742	9.94	9.19	8.69	25 x 64	pit s/b 2	50	MIDDLE TOWN	V
153.	41038	Cuboid	Complete	Perfect	Jasper	1.742	8.82	8.20	7.46	46x63x2	unstr atified	46	MIDDLE TOWN	V
154.	54473	Cuboid	Complete	Perfect	Grey stibe	1.743	12.25	9.72	6.71	65x64x1	2	40		
155.	19700	Cuboid	Complete	Perfect	Chert	1.757	9.85	9.60	8.05	54 x 58 x 2	1 a	35	MIDDLE TOWN	V
156.	21169	Cuboid	Complete	Perfect	Chert	1.773	9.82	9.69	8.14	45 x 43 x 2	18	279	MIDDLE TOWN	IV
157.	5501	Cuboid	Complete	Perfect	Chert	1.785	9.61	9.39	8.63	1x100x3	1	4		
158.	3886	Cuboid	Complete	Perfect	Chert	1.797	10.65	9.06	8.00	ZB-9	1			
159.	53305	Cuboid	Complete	Perfect	Chert	1.798	10.76	9.88	7.11	55x95x1	4	103	MIDDLE TOWN	V
160.	48112	Cuboid	Complete	Perfect	Chert	1.800	9.65	9.70	8.56	35 x 42 x 4	2	63		V
161.	52021	Cuboid	Complete	Perfect	Copper	1.805	10.20	10.18	6.67	35 x 32 x 1	1	5	LOWER TOWN	
162.	33805	Cuboid	Complete	Perfect	Chert	1.825	10.07	10.01	7.49	35 x 63 x 4	3	18	MIDDLE TOWN	V
163.	2902	Cuboid	Complete	Perfect	Limestone	1.829	10.06	9.02	7.22	XE.22/1	19	248-316	CASTLE	IV
164.	9809	Cuboid	Complete	Perfect	Chert	1.835	9.97	9.60	8.20	45 x 74	5	87	MIDDLE TOWN	IV
165.	4911	Cuboid	Complete	Perfect	Basalt	1.840	10.20	9.94	7.52	48x72xR.1N	2	26	CASTLE	VI
166.	195	Cuboid	Complete	Perfect	Shell	1.845	10.18	10.71	6.59	Zone 2	surfac e		CASTLE	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
167.	14256	Cuboid	Complete	Perfect	Carnelian	1.853	9.21	9.51	8.78	45 x 45 x 4	1	28	MIDDLE TOWN	V
168.	40796	Cuboid	Complete	Perfect	Agate	1.887	11.59	10.06	60.02	47 x 80 x 4	2	105	MIDDLE TOWN	V
169.	11145	Cuboid	Complete	Perfect	Jasper	1.891	10.87	10.86	8.89	45 x 64	3	56	MIDDLE TOWN	
170.	39230	Cuboid	Complete	Perfect	Chert	1.906	10.28	10.18	8.03	47 x 79	unstr atified		CASTLE	
171.	26005	Cuboid	Complete	Perfect	Chert	1.910	10.23	10.08	8.30	59 X 13	surfac e			
172.	20721	Cuboid	Complete	Perfect	Gabbro	1.915	8.93	8.31	9.53	48 x 45 x 3	1	248	SoC	IV/V
173.	5837	Cuboid	Complete	Perfect	Agate	1.921	10.18	10.11	8.44	48x82x1+2	1	10-15	SoC	IV
174.	21291	Cuboid	Complete	Perfect	Chert	1.928	10.70	10.23	7.69	45 x 43 x 2	17	257	MIDDLE TOWN	IV
175.	32024	Cuboid	Complete	Perfect	Limestone	1.928	9.80	9.60	8.79	55 x 3 x 1	1	50	MIDDLE TOWN	V
176.	2959	Cuboid	Complete	Perfect	Limestone	1.943	9.85	9.49	8.93	ZT.7/1	2	18		
177.	15792	Cuboid	Complete	Perfect	Sandstone	1.946	10.74	9.68	7.83	56 x 54 x 1	3	98	MIDDLE TOWN	V
178.	14778	Cuboid	Complete	Perfect	Basalt	1.965	8.67	8.34	7.00	55 x 52	surfac e		MIDDLE TOWN	V
179.	48619	Cuboid	Complete	Perfect	Chert	2.000	10.15	9.96	8.27	47 x 84 x 1	5	141	CASTLE	V
180.	27018	Cuboid	Complete	Perfect	Basalt	2.075	8.30	8.25	7.95	47 x 89 x 2	7	125-50	CASTLE	V
181.	16465	Cuboid	Complete	Perfect	Stone	2.076	10.05	10.01	5.70	15x24x3	28	302		
182.	14187	Cuboid	Complete	Perfect	Basalt	2.085	10.36	10.00	8.05	45 x 48 x 3	pit 1 surfac e	50	MIDDLE TOWN	
183.	18097	Cuboid	Complete	Perfect	Agate	2.091	10.68	10.18	8.69	57x32x3	4	190		IV
184.	29297	Cuboid	Complete	Perfect	Chert	2.190	10.40	10.37	8.87	45 x93 x 3	1	2	MIDDLE TOWN	V
185.	19224	Cuboid	Complete	Perfect	Limestone	2.271	9.71	9.55	6.22	54 X 58 X 1	3	13	M.PG	V/VI
186.	51635	Cuboid	Complete	Perfect	Copper	2.297	12.07	11.33	6.88	47 x 73 x 3	19	370	CASTLE	
187.	1483	Cuboid	Complete	Perfect	Basalt	2.322	10.25	10.16	9.81	XG.19/2	4	6	CASTLE	VI
188.	21591	Cuboid	Complete	Perfect	Limestone	2.537	10.81	10.77	8.73	57 x 57 x 2	15 a	390	BAILEY	IV
189.	43186	Cuboid	Complete	Perfect	Jasper	2.562	12.79	12.62	7.16	55 x 85 x 4	1	117	MIDDLE TOWN	V
190.	9872	Cuboid	Complete	Perfect	Copper	2.761	11.33	11.26	7.65	45 x 64 x 1	5	73		
191.	48678	Cuboid	Complete	Perfect	Agate	3.000	12.30	12.08	9.52	47.x x84 x 1	5	128	CASTLE	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
192.	19384	Cuboid	Complete	Perfect	Limestone	3.234	11.92	11.13	10.86	57 x 58 x 3	4	63	BAILEY	V
193.	23226	Cuboid	Complete	Perfect	Limestone	3.248	12.19	12.03	9.01	54 x 68 x 102	3	15		
194.	48483	Cuboid	Complete	Perfect	Sandstone	3.300	13.57	10.67	8.01	35 x 52 x 1	1	91	MIDDLE TOWN	
195.	52383	Cuboid	Complete	Perfect	Chert	3.356	12.10	11.91	10.40	35x32x4	1	24 - 30	LOWER TOWN	V
196.	30373	Cuboid	Complete	Perfect	Agate	3.378	12.96	12.62	9.72	55 x 93 x 3	1	16	MIDDLE TOWN	V
197.	11845	Cuboid	Complete	Perfect	Shell	3.380	14.50	12.33	7.64	45 x 40	pit s/b 1	66	MIDDLE TOWN	V
198.	18041	Cuboid	Complete	Perfect	Chert	3.388	12.19	11.75	10.46	35 x 94 x 4	4	84	MIDDLE TOWN	IV/V
199.	54460	Cuboid	Complete	Perfect	Chert	3.393	13.02	12.81	8.67	45x43x3	2c	77 - 99	MIDDLE TOWN	IV/V
200.	13794	Cuboid	Complete	Perfect	Chert	3.396	12.03	12.01	9.73	44x48x3	1	100	MIDDLE TOWN	IV
201.	12544 b	Cuboid	Complete	Perfect	Chert	3.416	12.10	11.79	10.66	55 x 74	2	40	MIDDLE TOWN	IV
202.	47007	Cuboid	Complete	Perfect	Agate	3.418	12.14	11.92	10.46	47 x 85	1	62	CASTLE	VI
203.	36616	Cuboid	Complete	Perfect	Chert	3.418	12.70	11.89	9.52	46 x 61 x 3	1	225	MIDDLE TOWN	IV
204.	43183	Cuboid	Complete	Perfect	Chert	3.430	12.35	11.69	10.07	47 x 63 x 3	5	20	CASTLE	VI
205.	30790	Cuboid	Complete	Perfect	Chert	3.436	12.19	11.50	11.30	65 x 23 x 1	unstr atified	46	MIDDLE TOWN	IV
206.	33964	Cuboid	Complete	Perfect	Stone	3.445	14.02	8.45	-	47x85x4	1	10	CASTLE	VI
207.	969	Cuboid	Complete	Perfect	Gabbro	3.456	12.88	12.03	8.93	A.13/1	2	18	CASTLE	VI
208.	34880	Cuboid	Complete	Perfect	Sandstone	3.469	12.22	12.00	9.96	45 x 23 x 4	1	5	MIDDLE TOWN	V
209.	19565	Cuboid	Complete	Perfect	Shell	3.475	14.85	13.16	7.44	57 x 54 x 1	4	97	BAILEY	V
210.	36349	Cuboid	Complete	Perfect	Chert	3.480	12.36	12.17	10.23	46x54x4	pit s/b 1	17		
211.	51874	Cuboid	Complete	Perfect	Chert	3.480	12.30	12.22	11.19	47x73x3	2	425	CASTLE	IV
212.	20319	Cuboid	Complete	Perfect	Chert	3.487	12.55	12.06	9.72	57 x 58 x 2	4	120	BAILEY	IV
213.	13545	Cuboid	Complete	Perfect	Chert	3.490	12.65	12.59	9.46	15 x 64 x 3	1	4	LOWER TOWN	V
214.	10764	Cuboid	Complete	Perfect	Agate	3.497	13.43	13.10	8.55	73 x 5	2	30		
215.	26899	Cuboid	Complete	Perfect	Basalt	3.498	12.85	12.57	9.07	47 x 79 x 3 x 4	3	60 - 70	CASTLE	VI
216.	24941	Cuboid	Complete	Perfect	Chert	3.501	12.89	12.28	9.85	24 x 9	unstr		LOWER TOWN	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
											atified			
217.	23424	Cuboid	Complete	Perfect	Chert	3.505	12.49	11.67	10.50	24 x 5 x 2	1	38	LOWER TOWN	IV
218.	52781	Cuboid	Complete	Perfect	Carnelian	3.511	12.18	11.96	11.40	47x73x3	28	580	CASTLE	
219.	22312	Cuboid	Complete	Perfect	Chert	3.511	12.63	11.82	10.16	47 x 99 x 2	2 c	225	CASTLE	IV
220.	7116	Cuboid	Complete	Perfect	Chert	3.515	13.08	12.38	9.93	35x64x4	1	6	MIDDLE TOWN	V
221.	38720	Cuboid	Complete	Perfect	Chert	3.517	12.58	12.33	9.84	45 x 53 x 2	10	207	MIDDLE TOWN	IV
222.	18178	Cuboid	Complete	Perfect	Chert	3.522	11.79	11.61	9.94	25x44x3	7	100		V
223.	18307	Cuboid	Complete	Perfect	Chert	3.533	12.13	11.76	10.30	57x57x1	1	27	MIDDLE TOWN	IV/V
224.	3320	Cuboid	Complete	Perfect	Chert	3.548	12.34	12.27	10.00	A 17/1	7	140	CASTLE	V
225.	9833	Cuboid	Complete	Perfect	Chert	3.568	12.52	12.38	10.15	45 x14	pit s/b 4	156	MIDDLE TOWN	IV
226.	41037	Cuboid	Complete	Perfect	Limestone	3.583	11.35	11.23	10.66	45 x 69 x 3	3	58	MIDDLE TOWN	IV
227.	22592	Cuboid	Complete	Perfect	Agate	3.586	11.93	11.34	11.08	54 x 67 x 3	3	33	MIDDLE TOWN	IV
228.	41039	Cuboid	Complete	Perfect	Sandstone	3.589	13.02	11.70	10.91	55 x 35 x 2	2	100	MIDDLE TOWN	V
229.	47319	Cuboid	Complete	Perfect	Chert	3.600	13.54	13.07	8.94	35x83x3	unstr atified		MIDDLE TOWN	
230.	43185	Cuboid	Complete	Perfect	Limestone	3.636	11.90	11.87	11.00	55 x 76 x 2	3	62	MIDDLE TOWN	IV
231.	14683	Cuboid	Complete	Perfect	Cherty limestone	3.645	12.98	12.93	9.23	56 x 55 x 3	1	70	MIDDLE TOWN	IV
232.	1741	Cuboid	Complete	Perfect	Chert	3.671	12.67	12.22	9.72	XK.19/1	3	57	CASTLE	VI
233.	45169	Cuboid	Complete	Perfect	Chert	3.682	12.23	12.10	10.54	47 x 84 x 1	1	100	CASTLE	IV
234.	16820	Cuboid	Complete	Perfect	Chert	3.684	12.80	12.59	9.90	56 x 51 x 2	10	275	MIDDLE TOWN	IV
235.	17784	Cuboid	Complete	Perfect	Agate	3.711	13.07	12.65	9.72	56x56x2	8	440	MIDDLE TOWN	IV
236.	27118	Cuboid	Complete	Perfect	Chert	3.741	13.42	12.62	9.33	48 x 38 x 3 x 4		800 - 850	MIDDLE TOWN	IV
237.	6593	Cuboid	Complete	Perfect	Gabbro	3.765	12.02	11.75	10.15	57x5x1	1	20 on slope	MIDDLE TOWN	IV
238.	46496	Cuboid	Complete	Perfect	Chert	3.767	13.07	12.98	10.02	47 x 75 x 4	3	17	MIDDLE TOWN	V
239.	23843	Cuboid	Complete	Perfect	Chert	3.808	12.65	12.49	10.06	54 x 58 x 4	3	98	MIDDLE TOWN	IV
240.	11114	Cuboid	Complete	Perfect	Basalt	3.850	14.33	13.67	7.90	45 x 4	1	5	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
241.	34878	Cuboid	Complete	Perfect	Chert	4.015	12.68	12.55	11.49	45x13x4	1	10	MIDDLE TOWN	
242.	18519	Cuboid	Complete	Perfect	Terracotta	4.129	16.21	15.83	11.49	57 x56 x1	1	8	BAILEY	
243.	16721	Cuboid	Complete	Perfect	Stone	4.136	12.39	11.18	11.29	56x55x4	2 R-8	180	MIDDLE TOWN	
244.	47223	Cuboid	Complete	Perfect	Stone	4.600	11.78	11.63	10.65	47x85x4	6	75	CASTLE	VI
245.	38135	Cuboid	Complete	Perfect	Sandstone	5.022	14.52	14.27	10.22	surface	surfac e		MIDDLE TOWN	
246.	15199	Cuboid	Complete	Perfect	Terracotta	5.307	14.86	14.63	10.15	56 x 54 x 3	1	47	MIDDLE TOWN	VI
247.	6645	Cuboid	Complete	Perfect	Terracotta	5.320	16.72	15.66	14.71	57x5x3	3	45	CASTLE	VI
248.	54483	Cuboid	Complete	Perfect	Stone	6.290	16.19	15.59	10.72	65x24x4	surfac e		MIDDLE TOWN	IV/V
249.	15680	Cuboid	Complete	Perfect	Basalt	6.406	14.70	14.38	12.44	35 x 53 4:1	2	80	MIDDLE TOWN	V
250.	9192	Cuboid	Complete	Perfect	Chert	6.522	17.00	14.70	10.56	45x4x2	5	152 - 163	MIDDLE TOWN	IV
251.	14211	Cuboid	Complete	Perfect	Sandstone	6.638	16.17	15.75	11.91	44 x 49 x 4	1	53	MIDDLE TOWN	V
252.	54118	Cuboid	Complete	Perfect	Black stone	6.691	12.41	12.35	11.93	47x74x21	21 b	420	CASTLE	IV
253.	7234	Cuboid	Complete	Perfect	Basalt	6.707	14.25	13.58	13.92	46 x 60 x 1+2	9	168 - 80		
254.	16536	Cuboid	Complete	Perfect	Agate	6.750	15.96	15.02	11.24	55x51x1	2	5		
255.	3816	Cuboid	Complete	Perfect	Chert	6.754	14.97	14.54	12.20	C.19/3	2	15-25	CASTLE	VI
256.	6561	Cuboid	Complete	Perfect	Chert	6.760	16.31	16.21	11.76	57 x 5 x3	1	30	CASTLE	VI
257.	17751	Cuboid	Complete	Perfect	Chert	6.783	14.85	14.14	13.70	47 x 50 x 3	9	175	CASTLE	IV
258.	54176	Cuboid	Complete	Perfect	Chert	6.784	15.72	15.59	11.54	47x84x1	16	535	CASTLE	IV
259.	33094	Cuboid	Complete	Perfect	Chert	6.815	16.55	16.42	10.89	45 X 84 Baulk	2	19	MIDDLE TOWN	V
260.	28945	Cuboid	Complete	Perfect	Chert	6.816	15.40	14.78	13.17	45 x 93 x 2	2	50	MIDDLE TOWN	V
261.	37072	Cuboid	Complete	Perfect	Chert	6.824	15.58	15.09	12.83	46 x 54 x 1	pit 2 s/b 1	48	MIDDLE TOWN	VI
262.	8373	Cuboid	Complete	Perfect	Chert	6.825	15.42	15.24	12.63	46 x 45 x1+2	2	190	MIDDLE TOWN	V
263.	15014	Cuboid	Complete	Perfect	Chert	6.833	15.33	15.24	12.21	15 x 34 x 3	2	176	LOWER TOWN	IV
264.	15021	Cuboid	Complete	Perfect	Chert	6.850	15.22	14.32	13.47	surface	surfac e		LOWER TOWN	
265.	11992	Cuboid	Complete	Perfect	Chert	6.860	15.63	15.60	12.60	65 x 4x2	3	42	MIDDLE TOWN	IV

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
266.	1689	Cuboid	Complete	Perfect	Chert	6.897	14.52	14.38	12.74	XJ.19/3	1	2	BAILEY	VI
267.	26544	Cuboid	Complete	Perfect	Basalt	6.905	14.84	14.28	12.86	58 x 18 x 3	2	145	BAILEY	V
268.	22101	Cuboid	Complete	Perfect	Chert	6.913	15.92	15.67	11.48	25 x 5 x 4	2	40	LOWER TOWN	V
269.	54459	Cuboid	Complete	Perfect	Agate	6.922	15.46	15.05	12.63					
270.	29833	Cuboid	Complete	Perfect	Agate	6.925	17.54	16.01	11.52	45 x 93 x 4	1	7	MIDDLE TOWN	V
271.	2053	Cuboid	Complete	Perfect	Chert	6.935	15.08	15.00	13.25	ZA.19/1	2	20 B	CASTLE	VI
272.	19496	Cuboid	Complete	Perfect	Chert	6.938	15.26	14.46	13.34	57 x 60 x2	3	138	BAILEY	V
273.	21945	Cuboid	Complete	Perfect	Shell	6.976	14.95	14.00	12.86	45 x 45	surfac e		MIDDLE TOWN	VI
274.	18085	Cuboid	Complete	Perfect	Chert	6.997	14.49	14.47	13.31	45 x 4 x 1	5	149	MIDDLE TOWN	IV
275.	54456	Cuboid	Complete	Perfect	Chert	7.022	15.82	15.32	12.07	25 x 24 x 2			LOWER TOWN	V
276.	9092	Cuboid	Complete	Perfect	Agate	7.027	17.18	15.81	10.94	48 x 92 x 4	37	675 - 80	CASTLE	III
277.	19226	Cuboid	Complete	Perfect	Chert	7.067	16.12	15.19	12.27	25 x63 x3	1	5	LOWER TOWN	V
278.	16875	Cuboid	Complete	Perfect	Basalt	7.091	17.00	16.01	12.11					
279.	25520	Cuboid	Complete	Perfect	Agate	7.108	15.54	14.52	13.15	23 x 10 x 4	4	96	LOWER TOWN	IV
280.	9802	Cuboid	Complete	Perfect	Basalt	7.642	15.44	14.62	13.99	35 x 94	4	40	MIDDLE TOWN	V
281.	20062	Cuboid	Complete	Perfect	Basalt	7.820	13.00	12.66	12.10	58 x 54 x 4	3	26	SoC	VI
282.	8502	Cuboid	Complete	Perfect	Basalt	8.051	15.43	13.72	13.17	35 x 44 x 4	9	110 - 20	MIDDLE TOWN	IV
283.	2929	Cuboid	Complete	Perfect	Limestone	10.063	17.63	15.96	15.61	XM.19/4	2	40	BAILEY	IV
284.	8513	Cuboid	Complete	Perfect	Shell	12.056	23.55	14.77	14.61	37x31x3	3	55		
285.	27629	Cuboid	Complete	Perfect	Basalt	12.201	18.03	17.52	15.92	67 x 52 x 1	6	130	BAILEY	IV
286.	14676	Cuboid	Complete	Perfect	Sandstone	12.590	19.78	19.50	16.92	56 x 52 x 2	1			
287.	10072	Cuboid	Complete	Perfect	Chert	13.529	20.68	19.93	15.03	25 x 64	pit s/b 2	80	LOWER TOWN	V
288.	7363	Cuboid	Complete	Perfect	Chert	13.601	19.85	19.40	15.20	57 x 15 x 2	3	85	MIDDLE TOWN	IV
289.	8397	Cuboid	Complete	Perfect	Chert	13.611	19.39	19.06	15.82	47x47x2	pit s/b 28	505 - 25	CASTLE	IV
290.	2375	Cuboid	Complete	Perfect	Chert	13.635	19.12	18.88	15.97	ZA 6/2	4	45	MIDDLE TOWN	V
291.	11219	Cuboid	Complete	Perfect	Chert	13.690	19.66	19.30	15.85	45 x 44	2	10-16	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
292.	12834	Cuboid	Complete	Perfect	Agate	13.694	20.77	20.36	13.43	55 x 64	1	5	MIDDLE TOWN	IV/V
293.	16369	Cuboid	Complete	Perfect	Chert	13.769	19.18	18.44	16.04	55 x 58 x 4	5	108	MIDDLE TOWN	IV
294.	40564	Cuboid	Complete	Perfect	Chert	13.875	20.34	19.72	15.19	25 x 83 x 2	1	33	LOWER TOWN	V
295.	21549	Cuboid	Complete	Perfect	Chert	13.899	19.86	19.16	16.07	58 x 62 x 4	1	150	BAILEY	IV/V
296.	10090	Cuboid	Complete	Perfect	Sandstone	14.003	22.18	21.61	16.91	45 x 54	pit s/b 2	29	MIDDLE TOWN	IV/V
297.	49454	Cuboid	Complete	Perfect	Sandstone	14.100	22.93	18.12	16.39	35x73	25	314	MIDDLE TOWN	IV
298.	3491	Cuboid	Complete	Perfect	Vesuvianite	14.683	17.95	17.69	13.90	J 19/2	8	270	CASTLE	IV
299.	1841	Cuboid	Complete	Perfect	Chert	14.797	20.06	19.99	15.69	XE-24	3	40	SoC	IV
300.	36219	Cuboid	Complete	Perfect	Chert	27.055	23.08	22.91	21.61	35 x 63 x 2	surface	200 - 05	MIDDLE TOWN	IV/V
301.	33384	Cuboid	Complete	Perfect	Chert	27.242	24.68	24.53	18.90	surface	surface		LOWER TOWN	
302.	22980	Cuboid	Complete	Perfect	Chert	27.246	25.34	24.58	18.01	25 x 8 x 4	3	80	LOWER TOWN	IV
303.	26979	Cuboid	Complete	Perfect	Chert	27.252	24.48	24.33	18.65	48 x 38	6	800 - 50	SR	IV/V
304.	5503	Cuboid	Complete	Perfect	Sandstone	27.355	25.13	24.44	20.99	37x79x2	1	Debris	ER	VI
305.	34227	Cuboid	Complete	Perfect	Chert	27.500	24.67	24.16	19.29	35 x 73 x 4	1	15	MIDDLE TOWN	V
306.	39245	Cuboid	Complete	Perfect	Limestone	29.242	24.77	24.20	20.84	47 x 74 x3	2	50	CASTLE	VI
307.	24513	Cuboid	Complete	Perfect	Limestone	29.480	26.44	25.61	17.55	47 x 88 x 2	7 b	212 - 24	CASTLE	IV
308.	54488	Cuboid	Complete	Perfect	Stone	34.680	31.74	22.48	21.99	surface	surface			
309.	46853	Cuboid	Complete	Perfect	Chert	54.398	30.28	30.26	24.77	surface	surface		BAILEY	
310.	39322	Cuboid	Complete	Perfect	Sandstone	57.759	39.73	38.79	22.27	47 x 74 x 1	3	76	CASTLE	V
311.	14999	Cuboid	Complete	Perfect	Limestone	116.375	40.68	38.77	31.87	56 x 55x 1	1	75	MIDDLE TOWN	VI
312.	21074	Cylindroid	Complete	Perfect	Shell	0.411	7.12	4.78	-					
313.	43443	Cylindroid	Complete	Perfect	Shell	0.536	7.00	-	5.76	47x94x2	humus	10	CASTLE	
314.	13112 a	Cylindroid	Complete	Perfect	Shell	0.569	7.01	-	6.46	46x43x2+3	11 o.p.a. 1	280		
315.	20550	Cylindroid	Complete	Perfect	Shell	0.683	7.62	-	7.30	58x54x1	4c	178		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
316.	39541	Cylindroid	Complete	Perfect	Shell	0.683	7.40	-	7.11	47x73x2	7	70		
317.	13920	Cylindroid	Complete	Perfect	Shell	0.696	7.40		7.32	44x48x3	2	84		
318.	20452	Cylindroid	Complete	Perfect	Shell	0.718	7.23	-	7.47	58x53x3	8	210		
319.	16679	Cylindroid	Complete	Perfect	Shell	0.720	7.96	-	7.69	67x19x1+4	2C	160-210		
320.	20957	Cylindroid	Complete	Perfect	Shell	0.749	8.02	-	6.32	58x55x4+58x 54x3	erosio n	235		
321.	9986	Cylindroid	Complete	Perfect	Shell	0.752	7.77		7.4	37x90	1	70		
322.	20963	Cylindroid	Complete	Perfect	Shell	0.773	7.85	6.74	-	58x55x4+58x 54x3	5b	220		
323.	29941	Cylindroid	Complete	Perfect	Shell	0.788	8.13	-	6.51	65x3x2	1	10	MIDDLE TOWN	
324.	9194	Cylindroid	Complete	Perfect	Shell	0.798	7.63	-	7.42	45x14x1	2	15		
325.	20887	Cylindroid	Complete	Perfect	Shell	0.801	8.03	-	6.60	58x54x3+58x 55x4	erosio n	215		
326.	20764	Cylindroid	Complete	Perfect	Shell	0.807	8.00		7.12	35x33x3	1	42		
327.	3639	Cylindroid	Complete	Perfect	Shell	0.841	8.14	-	7.14	A 13/1	10	395		
328.	24774	Cylindroid	Complete	Perfect	Shell	0.845	7.74	-	6.95	57x47x3&57 x51x2	26 to 29	371-458		
329.	28133	Cylindroid	Complete	Perfect	Shell	0.848	7.63	-	7.94	37x55x2+3	8	325		
330.	8178	Cylindroid	Complete	Perfect	Shell	0.849	17.75	-	4.63	47x47x4	4 w drain 1c	550-10		
331.	19788	Cylindroid	Complete	Perfect	Shell	0.849	7.48		7.76	47x46, 47/48	3	185-240		
332.	41315	Cylindroid	Complete	Perfect	Shell	0.852	12.40	5.25	-	35x83x1+2	24	448		
333.	20890	Cylindroid	Complete	Perfect	Shell	0.852	7.76	-	8.27	58x54x3+58x 55x4	erosio n	122		
334.	18390	Cylindroid	Complete	Perfect	Shell	0.858	7.82	-	7.64	58x52x1	1	8		
335.	21057	Cylindroid	Complete	Perfect	Shell	0.860	7.85		7.71	58x55x4+58x 54x3				
336.	16619	Cylindroid	Complete	Perfect	Shell	0.867	8.99	-	6.41	48x41x1	5	124-32		
337.	29700	Cylindroid	Complete	Perfect	Shell	0.867	7.83	-	7.14	57x8	surfac e	-		
338.	20706	Cylindroid	Complete	Perfect	Shell	0.867	7.62	-	8.50	58x52x2	4	110-125		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
339.	20479 b	Cylindroid	Complete	Perfect	Shell	0.872	8.04	-	7.68	58x53x3	8	215		
340.	20882	Cylindroid	Complete	Perfect	Shell	0.877	8.09	-	7.29	58x52x2	4	162		
341.	1382	Cylindroid	Complete	Perfect	Shell	0.894	8.32		7.12	XF-25/3	3			
342.	54545	Cylindroid	Complete	Perfect	Shell	0.901	7.55	-	7.27	58x31x2	debris	362		
343.	18871	Cylindroid	Complete	Perfect	Shell	0.902	7.36	-	8.14	58x54x3	4	115		
344.	1260	Cylindroid	Complete	Perfect	Shell	0.914	7.99	-	8.28	XE.22/1&2	down wash			
345.	10261	Cylindroid	Complete	Perfect	Shell	0.924	8.41	-	-	47x8x2	7	289		
346.	21811	Cylindroid	Complete	Perfect	Shell	0.935	8.50	7.80	7.12	58 x 54 x 4	3	205	BAILEY	IV
347.	20453	Cylindroid	Complete	Perfect	Shell	0.952	8.01	-	7.65	58x53x3	8	195		
348.	44743	Cylindroid	Complete	Perfect	Shell	0.956	8.16	-	8.13	47x95x1	7	165	CASTLE	
349.	721	Cylindroid	Complete	Perfect	Shell	0.994	8.21	-	7.40	D-19/2	3	112-18		
350.	20959	Cylindroid	Complete	Perfect	Shell	1.001	8.40	-	7.51	58x54x3+58x 55x4	erosio n	228		
351.	54553	Cylindroid	Complete	Perfect	Shell	1.033	9.10	-	7.11	58x53x3	8	195		
352.	537	Cylindroid	Complete	Perfect	Shell	1.076	14.14	-	6.21	XE-22	surfac e			
353.	28732	Cylindroid	Complete	Perfect	Stone	1.464	11.64	8.80	-	45x93x2	2	37	MIDDLE TOWN	
354.	32616	Cylindroid	Complete	Perfect	Terracotta	1.508	11.81	9.24	-	38x31x1	9	360		
355.	43393	Cylindroid	Complete	Perfect	Terracotta	2.147	13.01	10.31	-	25x93x3	pit 3	1	LOWER TOWN	
356.	41832	Cylindroid	Complete	Perfect	Sandstone	2.216	12.27	10.80	-	47 x 63 x 3	8	70	CASTLE	
357.	11949	Cylindroid	Complete	Perfect	Shell	2.258	16.46	7.85	-	65x34x1	4	100		
358.	11197	Cylindroid	Complete	Perfect	Shell	2.514	11.74	8.88	-	46x43x2-3	6	215		
359.	2299	Cylindroid	Complete	Perfect	Shell	3.147	22.07	-	8.66	A-16/4	3	57		
360.	17765	Cylindroid	Complete	Perfect	Stone	6.903	18.65	10.09	-	58x11x2	3	56	BAILEY	V
361.	14357	Cylindroid	Complete	Perfect	Sandstone	12.127	15.80	24.47	-	47 x 50 x 1	2	17		
362.	17891	Cylindroid	Complete	Perfect	Shell	12.757	14.70 -90	-	23.00	65 x 34 x 3	3	20	MIDDLE TOWN	IV
363.	34092 a	Cylindroid	Complete	Perfect	Shell	20.094	25.39	15.86	-	47x85x1	1	20		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
364.	18068	Cylindroid	Complete	Perfect	Stone	54.506	32.55	32.60	-	45x4x1	5	149	MIDDLE TOWN	IV
365.	6923	Cylindroid	Complete	Perfect	Limestone	67.275	36.05	31.11	-	57x5x2	8	130		
366.	34386	Cylindroid	Complete	Perfect	Sandstone	77.700	37.00	30.74	-	47x84x2	1	40	CASTLE	V
367.	54404	Cylindroid	Complete	Perfect	Limestone	13720.000	19.70	14.30	-	55x73	1		MIDDLE TOWN	IV/V
368.	54546	Discoid	Complete	Perfect	Shell	0.092	4.53	-	2.18	58x31x2	debris	362		
369.	35317	Discoid	Complete	Perfect	Shell	0.128	5.34	-	2.52	47x85x2	4	88		
370.	6740	Discoid	Complete	Perfect	Shell	0.202	5.69	3.19	-	57x5x4	1 R-3N	5		
371.	54469	Discoid	Complete	Perfect	Black stone	0.230	6.68	2.83	-		unstratified	-	open area	
372.	47386	Discoid	Complete	Perfect	Jasper	0.284	6.60	-	3.23	35 x 73	5	108		
373.	38371	Discoid	Complete	Perfect	Shell	0.316	6.68	4.13	-	55x82x2	3	18		
374.	38315	Discoid	Complete	Perfect	Jasper	0.522	10.01	4.30	-	45x53x2	8	156		
375.	18290	Discoid	Complete	Perfect	Shell	0.692	11.06	9.50	3.23	57x57x3	1	-45		
376.	50018	Discoid	Complete	Perfect	Shell	0.713	8.93	-	4.79	37x78x1	1	5		
377.	53041	Discoid	Complete	Perfect	Shell	0.775	9.45	9.05	4.80	35x42x1	1	5	LOWER TOWN	
378.	18911	Discoid	Complete	Perfect	Shell	1.041	10.16		5.32	57x56x1	2	34	q	
379.	1502	Discoid	Complete	Perfect	Shell	1.107	9.32	6.42		xk-19/4	1	10		
380.	27071	Discoid	Complete	Perfect	Shell	1.119	10.64	5.29	-	47x35x2	surface	surface		
381.	41203	Discoid	Complete	Perfect	Shell	1.245	10.45	5.40	-	55x86x2	2	20		
382.	35896	Discoid	Complete	Perfect	Agate	1.400	9.08	5.32	-	35x63x2	13	125		
383.	14913	Discoid	Complete	Perfect	Terracotta	1.470	11.61	11.58	-	55 x 52x1	Room 1	12	MIDDLE TOWN	V
384.	9891	Discoid	Complete	Perfect	Stone	1.840	11.65	5.43	-	35x53x3	10	168	MIDDLE TOWN	IV
385.	50560	Discoid	Complete	Perfect	Shell	1.861	13.01	-	6.20	58x9	2	70		
386.	18523	Discoid	Complete	Perfect	Shell	2.265	13.08 -.32	7.06	-	57x58x1	1	43		
387.	46015	Discoid	Complete	Perfect	Grey Limestone	3.119	14.46	13.89	8.44	35x63x1	2	115	MIDDLE TOWN	V
388.	15363	Discoid	Complete	Perfect	Quartz	3.318	16.00	6.98	-	56x55x1	2	150	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
389.	19831 a	Discoid	Complete	Perfect	Stone	3.500	15.29	7.51	-	54x58x2	1a	35	MIDDLE TOWN	V
390.	50310	Discoid	Complete	Perfect	Sandstone	3.539	15.50	8.80	-	37x78x2	1	36		
391.	33818	Discoid	Complete	Perfect	Terracotta	3.539	21.03	6.82	-	45x13x3	3	28		
392.	40372	Discoid	Complete	Perfect	Shell	3.624	15.50	14.42	7.98	55 x 76 x 1	4	63	MIDDLE TOWN	IV
393.	38350	Discoid	Complete	Perfect	Jasper	3.813	11.88	7.62	-	55x82x1	2	11	MIDDLE TOWN	IV
394.	15654	Discoid	Complete	Perfect	Sandstone	5.257	18.07	8.71	-	56x55x4	1 R 7	130	MIDDLE TOWN	V
395.	33595	Discoid	Complete	Perfect	Jasper	5.600	17.05	9.12	-	35x83x2	2	15+5		
396.	28608	Discoid	Complete	Perfect	Terracotta	5.725	21.06	20.71	6.78	55x3x4	pit s/b 1	78	MIDDLE TOWN	VI
397.	37143	Discoid	Complete	Perfect	Sandstone	7.030	20.83	8.37	-	35x63x4	3	27		
398.	19883	Discoid	Complete	Perfect	Stone	7.246	19.06	10.47	-	57x58x4	pit-1	65-80		
399.	43713	Discoid	Complete	Perfect	Terracotta	7.500	23.55	21.78	11.87	37 x 46 x 4	23	960	ER	IV/V
400.	19776	Discoid	Complete	Perfect	Shell	9.795	22.93	9.08	-	47x46+47x4 8	3	185-40		
401.	54480	Discoid	Complete	Perfect	Sandstone	10.174	32.39	5.38	-	45x4x1	2a	62	MIDDLE TOWN	V
402.	18081	Discoid	Complete	Perfect	Shell	12.735	24.45	23.47	10.88	35x64x3	3	32		
403.	11929	Discoid	Complete	Perfect	Shell	15.910	27.04	26.94	10.88	57 x 17	4	225	BAILEY	IV
404.	50042	Discoid	Complete	Perfect	Shell	33.796	31.78	16.24	-	47 x 74 x 3	6	162	CASTLE	V
405.	36160	Discoid	Complete	Perfect	Terracotta	66.057	58.85	20.29	-	48x29x1	2	136		
406.	10162	Hemispheroi	Complete	Perfect	Chert	0.682	9.90	5.19	-	37x80x4	2	170		
407.	53122	Hemispheroi	Complete	Perfect	Stone	17.210	27.75	27.29	12.18	58x39	5	120	BAILEY	IV
408.	50048	Ovate	Complete	Perfect	Carnelian	3.929	20.85	16.90	6.65	47 x 84 x 1	6	158	CASTLE	V
409.	54478	Ovate	Complete	Perfect	Gabbro	27.290	36.34	29.50	12.45	35x94x4	1	15-23	MIDDLE TOWN	V
410.	3525	Pebble	Complete	Perfect	Grey sandstone	225.572	49.51	48.35	50.30	XF23/2	MBR 1B	makeup (brick work)	CASTLE	I/II
411.	1392	Pyramidal	Complete	Perfect	Copper	0.656	3.58	3.42	-	XJ19 Qd.1	1	40	CASTLE	VI
412.	27137	Spheroid	Complete	Perfect	Shell	0.321	6.52	4.62	-	47x79x3x4				
413.	53661	Spheroid	Complete	Perfect	Chalcedony	0.393	6.71	-	5.08	47 x 84 x 1	13	425	CASTLE	V/VI

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
414.	28528	Spheroid	Complete	Perfect	Agate	0.519	7.86	7.69	5.82	55 x 3 x 4	pit s/b 1	63	MIDDLE TOWN	V
415.	26572	Spheroid	Complete	Perfect	Serpentine	0.570	8.08	7.96	5.31	36 x 42	1	100-70		V
416.	6342	Spheroid	Complete	Perfect	Agate	0.636	8.49	5.19	-	48x14x4	2	163		
417.	54466	Spheroid	Complete	Perfect	Chalcedony	0.682	8.00	5.75	-	55x52	1	16	MIDDLE TOWN	V
418.	40614	Spheroid	Complete	Perfect	Jasper	0.810	8.06	7.76	-	35x83x1+2	18	360	MIDDLE TOWN	IV
419.	21646	Spheroid	Complete	Perfect	Shell	0.825	7.90	7.64		58x54x3	6c	298		
420.	24331	Spheroid	Complete	Perfect	Shell	0.853	9.10	5.62		57x10x4	2	32		
421.	34643	Spheroid	Complete	Perfect	Shell	0.892	9.12	8.96	6.40	45/23x4	1	5	MIDDLE TOWN	
422.	1179	Spheroid	Complete	Perfect	Shell	0.915	8.65	7.24	-	XE 22/3+4	down wash			
423.	15146	Spheroid	Complete	Perfect	Agate	0.945	9.92	9.83	5.45	35 x 53 x 1	1	65	LOWER TOWN	V
424.	30634	Spheroid	Complete	Perfect	Shell	0.967	9.44	-	6.38	66x54x1	1	8		
425.	19840	Spheroid	Complete	Perfect	Agate	0.974	10.15	9.97	5.65	58x51x1	Debri s1 s/b 3	110	BAILEY	V/VI
426.	47329	Spheroid	Complete	Perfect	Jasper	1.070	11.40	10.71	7.50	35x73	3	89	MIDDLE TOWN	V
427.	27245	Spheroid	Complete	Perfect	Agate	1.121	10.26	10.24	6.71	46 x25	surfac e	surface	MIDDLE TOWN	
428.	9959	Spheroid	Complete	Perfect	Agate	1.188	10.19	9.94	7.94	45x34x2	3	35	MIDDLE TOWN	V
429.	54547	Spheroid	Complete	Perfect	Shell	1.297	10.06	-	7.13	55x74x4	45	110		
430.	54463	Spheroid	Complete	Perfect	Agate	1.358	10.87	7.75	-	B 19/3	3	70-100	MIDDLE TOWN	IV
431.	48625	Spheroid	Complete	Perfect	Shell	1.379	11.10	-	6.50	47x84x2 R-9	5	151	CASTLE	
432.	19833	Spheroid	Complete	Perfect	Chalcedony	1.467	10.57	9.48	-	54 x 58 x 2	1 a	24	MIDDLE TOWN	IV
433.	46902	Spheroid	Complete	Perfect	Chalcedony	1.478	10.50	8.33	-	47x84	Baulk remo ving		CASTLE	
434.	54481	Spheroid	Complete	Perfect	Carnelian	1.510	10.99	7.47	-	55x47x1	2	42	MIDDLE TOWN	
435.	54458	Spheroid	Complete	Perfect	Agate	1.525	10.91	10.79	8.42	XA 19	2	15-20	CASTLE	IV
436.	31189	Spheroid	Complete	Perfect	Agate	1.526	10.75	8.30	-	65x33x2	2	4	CASTLE	IV
437.	50688	Spheroid	Complete	Perfect	Chert	1.668	11.20	11.11	9.18	47x84x1 R.5	5	130	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
438.	9890	Spheroid	Complete	Perfect	Agate	1.750	11.79	11.72	8.05	55 x 4x2	1	56	MIDDLE TOWN	IV
439.	36655	Spheroid	Complete	Perfect	Agate	1.754	11.22	11.04	8.44	45 x 3 x 3	5	135	MIDDLE TOWN	IV
440.	51788	Spheroid	Complete	Perfect	Agate	1.757	12.00	8.30	-	suface			MIDDLE TOWN	
441.	772	Spheroid	Complete	Perfect	Agate	1.783	11.69	7.87	-	c-19/3	1a	18		
442.	34090	Spheroid	Complete	Perfect	Agate	1.799	11.94	11.96	7.59	47x85x1	1	18	CASTLE	VI
443.	52550	Spheroid	Complete	Perfect	Stone	1.802	12.64	7.85	-	35x32x4	2	30 - 40	LOWER TOWN	V
444.	6829	Spheroid	Complete	Perfect	Agate	1.810	12.11 -.20	-	7.46	57x5x2	5	107	CASTLE	V
445.	48688	Spheroid	Complete	Perfect	Agate	1.876	11.60	9.90	-	47 x 84 x 1	5	143	CASTLE	V
446.	32962	Spheroid	Complete	Perfect	Stone	2.011	10.80	7.66	-	45x94 N.Baulk	1	15	MIDDLE TOWN	V
447.	46997	Spheroid	Complete	Perfect	Terracotta	2.211	11.29 -.89	10.47	-	35x73	surfac e			
448.	4510	Spheroid	Complete	Perfect	Agate	2.267	11.72	10.03	-	A 17/1+2	16	290 - 05	CASTLE	IV
449.	18023	Spheroid	Complete	Perfect	Agate	2.671	13.11	10.37	-	35x64x2	2	31	MIDDLE TOWN	V
450.	4125	Spheroid	Complete	Perfect	Agate	2.707	12.98 -.74	11.55	-	A.16/3	8	150 - 160	CASTLE	V
451.	49400	Spheroid	Complete	Perfect	Agate	2.800	13.10 -.16	10.94	-	R.5 47x84x1	5	138	CASTLE	V
452.	54548	Spheroid	Complete	Perfect	Shell	2.944	13.83	13.29	9.31	55x64x4	35	75		
453.	39103	Spheroid	Complete	Perfect	Agate	3.488	15.04	14.93	8.94	35 x 73 x 1	2	25	MIDDLE TOWN	V
454.	560	Spheroid	Complete	Perfect	Agate	3.497	14.51 -.73	10.54	-	H 19/4	1		CASTLE	VI
455.	37238 a	Spheroid	Complete	Perfect	Agate	3.505	16.06	15.77	8.49	45 x 73 x 4	3	66	MIDDLE TOWN	V
456.	16946	Spheroid	Complete	Perfect	Soapstone	3.806	16.59	14.64	9.23	44x45x2	3	14	MIDDLE TOWN	
457.	28379	Spheroid	Complete	Perfect	Agate	3.997	14.93	14.73	11.65	55x3x4	1	40	MIDDLE TOWN	
458.	54470	Spheroid	Complete	Perfect	Agate	3.999	15.77	10.43	-					
459.	47247	Spheroid	Complete	Perfect	Chert	4.110	15.06	14.88	12.43	47x85x4	6	75 - 78	CASTLE	
460.	47970	Spheroid	Complete	Perfect	Terracotta	4.883	16.34	12.75	-	48x98	6	260		
461.	47915	Spheroid	Complete	Perfect	Agate	5.028	15.21	14.94	14.30	SR.1	surfac e			

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
462.	1562	Spheroid	Complete	Perfect	Agate	7.388	17.81	17.57	15.38	XE 23/2	unstr atified	180	CASTLE	IV
463.	46990	Spheroid	Complete	Perfect	Stone	13.395	22.77	17.17	-	47x85	1	57		
464.	15657	Spheroid	Complete	Perfect	Basalt (olivine)	13.403	21.61	21.52	17.19	56 x 55 x 4	1	130	CASTLE	VI
465.	10133	Spheroid	Complete	Perfect	Limestone	17.257	25.58	24.67	16.91	45x84x3	2	25	MIDDLE TOWN	V
466.	3507	Spheroid	Complete	Perfect	Agate	26.989	27.96	27.91	22.90	A 16/4	4	155 - 80	CASTLE	
467.	52310	Spheroid	Complete	Perfect	Stone	53.767	34.54	34.39	30.51	35x32x4	1	24	LOWER TOWN	V
468.	50743	Spheroid	Complete	Perfect	Limestone	112.716	43.62	43.36	39.20	47x23x3	4	65	CASTLE	VI
469.	18602	Spheroid	Complete	Perfect	Sandstone	118.150	48.63	48.07	28.78	25 x 73 x3	1	40	LOWER TOWN	V
470.	54446	Spheroid	Complete	Perfect	Stone	131.643	48.55	34.23	-	47x84x1	5	147 - 49	CASTLE	V
471.	54522	Spheroid	Complete	Perfect	Stone	134.852	48.52	35.30	-					
472.	9025	Spheroid	Complete	Perfect	Sandstone	155.879	49.08	46.89	43.38	57 x 5 x 3	2 R- 3s	45	CASTLE	VI
473.	54444	Spheroid	Complete	Perfect	Stone	266.476	60.74	47.28	-	47x84x1	5	147 - 49	CASTLE	V
474.	54490	Spheroid	Complete	Perfect	Stone	299.617	64.51	62.71	43.52	surface			MIDDLE TOWN	
475.	54529	Spheroid	Complete	Perfect	Sandstone	316.188	60.52	59.31	58.63	47x74x3	3	35	CASTLE	
476.	37935	Spheroid	Complete	Perfect	Sandstone	360.403	63.44	62.13	55.90	47x85x1	1	20	CASTLE	
477.	54447	Spheroid	Complete	Perfect	Stone	390.818	63.01	48.75	-	47x84x2	5	151	CASTLE	V
478.	54516	Spheroid	Complete	Perfect	Limestone	530.000	75.23	74.00	60.96					
479.	54514	Spheroid	Complete	Perfect	Yellow limestone	1330.000	105.0 2	76.26	-	47x46x1	1	10	CASTLE	VI
480.	54415	Spheroid	Complete	Perfect	Limestone	2690.000	13.00	10.60	-	47x77	3	86	CASTLE	VI
481.	8257	Tabloid	Complete	Perfect	Shell	0.528	9.30	7.80	2.72	57 x 5 x3	15	285	MIDDLE TOWN	
482.	10403	Tabloid	Complete	Perfect	Shell	0.542	8.47	7.39	3.50	55x44x1	2	23		
483.	18222	Tabloid	Complete	Perfect	Shell	0.581	10.18	8.09	3.09	surface finding				
484.	14270	Tabloid	Complete	Perfect	Shell	0.993	11.09	10.96	3.35	48 x 41 x1	1	34	CASTLE	V/VI
485.	54484	Tabloid	Complete	Perfect	Shell	1.155	12.34	9.95	3.84	65x54x1	2	20-30	MIDDLE TOWN	
486.	18213	Tabloid	Complete	Perfect	Shell	1.777	14.63	14.11	4.18	suface				
487.	51501	Tabloid	Complete	Perfect	Shell	2.032	13.34	11.44	5.15	47 x 73 x 3	18	345	CASTLE	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
488.	33021	Tabloid	Complete	Perfect	Shell	2.147	16.05	12.73	4.31	67x32x2	1	50		
489.	16239	Tabloid	Complete	Perfect	Olivine	3.443	15.65	15.39	6.16	55x84	3	80	MIDDLE TOWN	IV
490.	18422	Tabloid	Complete	Perfect	Siltstone	3.550	15.02	11.15	6.83	58x55x3	1	150	BAILEY	IV/V
491.	18401	Tabloid	Complete	Perfect	Shell	6.668	19.00	18.40	7.67	28 x 51 x 2/2	1	50	EMB.	V/VI
492.	6756	Cuboid	Complete	Perfect	Copper	5.701	13.81	12.42	12.22	47 x 48 x 4	23	420-430	CASTLE	
493.	20006	Cuboid	Complete	Patinated	Copper	1.985	10.79	9.25	8.96	45 x 43 x 2	6	83-87		
494.	42639	Cuboid	Complete	Patinated	Copper	4.047	13.28	12.42	9.00	48 x 68	16	500	S.R.	V
495.	54414	Discoid	Complete	Partly Chipped	Limestone	260.000	7.50	2.50	-	48x57	2	65	SoC	V
496.	38998	Cuboid	Complete	Slightly Corroded	Copper	0.765	7.79	7.49	3.85	47 x 47 x 2	3	76	CASTLE	VI
497.	25442	Cuboid	Complete	Slightly Corroded	Copper	1.548	7.47	7.26	6.35	37 x 64 x 3	2	20	MIDDLE TOWN	
498.	17569	Cuboid	Complete	Slightly Corroded	Copper	1.565	9.30	9.18	6.81	48 x 41 x 1	6	200-202	CASTLE	
499.	53002	Cuboid	Complete	Slightly Corroded	Copper	3.067	12.70	12.30	7.48	46 x x61 x 3	1(debris)	310	CASTLE	
500.	964	Amorphous	Complete	Slightly Chipped	Shell	0.765	7.59	-	7.47	XH 19	1			
501.	52499	Barrel	Complete	Slightly Chipped	Agate	1.275	9.50	8.27	-	55 x 37 x 1	2	75	MIDDLE TOWN	IV
502.	15078	Cuboid	Complete	Slightly Chipped	Shell	1.615	10.70	10.42	5.74	47 x 50 x 4	1	46	MIDDLE TOWN	V
503.	12544 a	Cuboid	Complete	Slightly Chipped	Chert	3.396	12.10	11.79	10.66	55 x 74	2	40	MIDDLE TOWN	IV
504.	9023	Cuboid	Complete	Slightly Chipped	Terracotta	5.195	16.28	15.62	13.92	57 x 5 x 3	2	50	CASTLE	VI
505.	3025	Cuboid	Complete	Slightly Chipped	Chert	6.296	16.98	16.83	9.92	A.18/1	6	15 - 30	CASTLE	VI
506.	46381	Cuboid	Complete	Slightly Chipped	Terracotta	6.400	22.51	19.85	9.45	35 x 63 x 2	2	108	MIDDLE TOWN	IV
507.	48158	Cuboid	Complete	Slightly Chipped	Chert	6.800	15.90	14.99	12.81	35 x 22 x1	1	16	LOWER TOWN	V
508.	46623	Cuboid	Complete	Slightly Chipped	Agate	6.814	15.86	15.32	16.22	55x86xBaulk	4	74 - 90	MIDDLE TOWN	IV
509.	22743	Cuboid	Complete	Slightly Chipped	Chert	13.612	18.90	18.73	16.35	24 x 7 x 1	3	25	LOWER TOWN	IV
510.	53828	Cuboid	Complete	Slightly Chipped	Agate	13.766	19.19	19.06	16.07	47x61x4		510	CASTLE	IV
511.	9761	Cuboid	Complete	Slightly Chipped	Shell	14.115	14.34	11.10	17.15					
512.	26175	Cuboid	Complete	Slightly Chipped	Shell	26.484	28.17	23.33	15.72			270 - 78	SR-3	IV/V
513.	54461	Cuboid	Complete	Slightly Chipped	Chert	26.955	23.68	22.67	20.80	65x44x1	3	75	MIDDLE TOWN	IV
514.	18603	Cuboid	Complete	Slightly Chipped	Chert	26.970	23.39	23.30	20.95	45 x45 x1	2		MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
515.	10363	Cuboid	Complete	Slightly Chipped	Basalt	30.787	28.39	28.13	16.24	55 x 4	pit s/b 2	45	MIDDLE TOWN	IV
516.	25984	Cuboid	Complete	Slightly Chipped	Sandstone	39.465	33.82	33.71	20.71	25 x 5 x 2	14	159 - 64	LOWER TOWN	IV
517.	1168	Cuboid	Complete	Slightly Chipped	Chert	53.992	29.32	29.17	26.62	XE 22/3+4	unstr atified	150	CASTLE	V
518.	10724	Cuboid	Complete	Slightly Chipped	Sandstone	61.042	32.13	29.55	27.14	25x24x1	2	15	LOWER TOWN	V
519.	47039	Cuboid	Complete	Slightly Chipped	Limestone	130.400	42.08	35.43	35.83	47 x 85	1	58	CASTLE	VI
520.	37238 b	Cuboid	Complete	Slightly Chipped	Chert	136.720	43.13	42.42	30.78	45x73x4	3	66	MIDDLE TOWN	
521.	54421	Cuboid	Complete	Slightly Chipped	Gray Limestone	1337 cal.	84.60	80.50	80.00					
522.	12096	Cylindroid	Complete	Slightly Chipped	Shell	0.658	7.19	6.77	-	46x36	2	50		
523.	22818	Cylindroid	Complete	Slightly Chipped	Terracotta	1.300	10.15	10.09	9.87	57 x 57 x 2	21 a	360	MIDDLE TOWN	IV
524.	50837	Cylindroid	Complete	Slightly Chipped	Terracotta	3.132	15.39	14.49	11.85	48x99	4	105		
525.	37298	Cylindroid	Complete	Slightly Chipped	Terracotta	9.670	25.90	14.74	-	35x63x4	6	61		
526.	37293	Cylindroid	Complete	Slightly Chipped	Basalt	14.570	19.86	19.62	20.02	35 x 63 x 4	6	59	MIDDLE TOWN	V
527.	17779	Cylindroid	Complete	Slightly Chipped	Terracotta	15.023	25.28	24.70	19.29	47 x 98 x 2	3 b	245	CASTLE	IV
528.	41367	Cylindroid	Complete	Slightly Chipped	Sandstone	16.401	27.10	26.61	19.00	45 x 69 x 4	1	12	MIDDLE TOWN	V
529.	25143	Cylindroid	Complete	Slightly Chipped	Stone	29.876	28.06	28.04	-	26x2x4	2	65	LOWER TOWN	IV
530.	18373	Cylindroid	Complete	Slightly Chipped	Sandstone	34.405	23.44	22.97	34.29	57 x 57 x 3	2	64		
531.	31308	Cylindroid	Complete	Slightly Chipped	Stone	44.875	39.58	37.19	27.27	65x33x4	surfac e		MIDDLE TOWN	
532.	44447	Cylindroid	Complete	Slightly Chipped	Sandstone	102.620	51.63	48.74	40.81	surface	surfac e			
533.	54443	Cylindroid	Complete	Slightly Chipped	Stone	270.543	66.05	44.06	-	54x68x1	1	+40 - +23		
534.	45681	Discoid	Complete	Slightly Chipped	Shell	1.714	11.52	11.36	6.65	37x37x2	11	365		
535.	33788	Discoid	Complete	Slightly Chipped	Sandstone	4.220	22.11	21.71	7.36	45x23x3	3	23		
536.	34192	Discoid	Complete	Slightly Chipped	Terracotta	4.350	24.02	6.92	-	35x63x4	4	55		
537.	34127	Discoid	Complete	Slightly Chipped	Terracotta	5.227	19.64	11.68	-	45x23x1	1	6	MIDDLE TOWN	
538.	9074	Discoid	Complete	Slightly Chipped	Shell	6.344	18.95	18.35	9.32	surface	surfac e			

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
539.	37147	Discoid	Complete	Slightly Chipped	Stone	7.600	24.89	8.54	-	35x63x4	6	56	MIDDLE TOWN	V
540.	34430	Discoid	Complete	Slightly Chipped	Terracotta	8.013	25.83	6.73	-	35x73x4	3	33	MIDDLE TOWN	
541.	34032	Discoid	Complete	Slightly Chipped	Terracotta	10.989	34.00	30.93	11.01	67x21x1	4	170-75		
542.	35547	Discoid	Complete	Slightly Chipped	Terracotta	15.734	34.65	10.58	-	46x54x2	s/b 1	40	MIDDLE TOWN	
543.	35455	Discoid	Complete	Slightly Chipped	Terracotta	18.813	37.63	12.06	-	47x85x2	4	95	CASTLE	
544.	36161	Discoid	Complete	Slightly Chipped	Terracotta	20.020	40.68	10.82	-	48x29x1	2	142		
545.	34003	Discoid	Complete	Slightly Chipped	Terracotta	25.867	41.50	12.20	-	35x63x3	5	26		
546.	35287	Discoid	Complete	Slightly Chipped	Sandstone	46.723	55.72	12.82	-	35x63x1	pit 1	64		
547.	36278	Discoid	Complete	Slightly Chipped	Sandstone	47.224	47.62	16.78	-	67x21x1	6	200-08		
548.	35298	Discoid	Complete	Slightly Chipped	Sandstone	62.676	55.49	49.60	18.18	37x56x4	8	210		
549.	33914	Discoid	Complete	Slightly Chipped	Stone	99.538	62.21	60.74	20.92	35x83x2	2	7-18		
550.	54412	Discoid	Complete	Slightly Chipped	Limestone	570.000	8.20	4.30	-	58x21x3	13	50	BAILEY	V
551.	29988	Hemispheroi	Complete	Slightly Chipped	Limy standstone	550.000	10.70	4.60	-					
552.	54437	Pebble	Complete	Slightly Chipped	Stone	520.000	75.26	62.96	-	47x84x1	5	139	CASTLE	IV
553.	18710	Prismatic	Complete	Slightly Chipped	Jasper	13.689	20.12	15.82	15.52	25x73x3	1	48	LOWER TOWN	
554.	54498	Spheroid	Complete	Slightly Chipped	Chalcedony	1.503	10.08	9.07	-	48x74x2	3	65		
555.	45758	Spheroid	Complete	Slightly Chipped	Shell	2.377	12.82	12.24	8.47	55x89x2	1	7	MIDDLE TOWN	
556.	54486	Spheroid	Complete	Slightly Chipped	Stone	3.640	13.40	13.29	9.97	25x7x1	1	12	LOWER TOWN	V
557.	9463	Spheroid	Complete	Slightly Chipped	Agate	3.955	15.24	14.94	11.72	45x94x7	2a	46	MIDDLE TOWN	
558.	54479	Spheroid	Complete	Slightly Chipped	Stone	4.318	16.63	16.21	11.83	45x94x1	2	26	MIDDLE TOWN	
559.	43193	Spheroid	Complete	Slightly Chipped	Shell	4.505	15.81	15.71	11.35	47x74x1	2	60	CASTLE	VI
560.	14159	Spheroid	Complete	Slightly Chipped	Agate	5.293	16.44	16.11	13.26	45x41x3	2	4	MIDDLE TOWN	V
561.	1870	Spheroid	Complete	Slightly Chipped	Agate	6.738	17.74	14.80	-	ZA 3/2	1	10	MIDDLE TOWN	V
562.	45892	Spheroid	Complete	Slightly Chipped	Basalt	7.767	16.87	16.35	12.95	47x92x2	2	74	CASTLE	VI
563.	14262	Spheroid	Complete	Slightly Chipped	Shell	8.546	18.80	16.39	16.29	45x48x3	1	57	MIDDLE TOWN	V
564.	1480	Spheroid	Complete	Slightly Chipped	Stone	9.019	17.62	16.02	16.39	XG 19/3	2	1		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
565.	46623 b	Spheroid	Complete	Slightly Chipped	Limestone	11.418	20.50	19.14	18.24	55x86xbaulk	4	74-90		
566.	3919	Spheroid	Complete	Slightly Chipped	Terracotta	16.217	27.35	27.33	18.20	XF.22/4	15/16 ?	147 - 55		
567.	9470	Spheroid	Complete	Slightly Chipped	Terracotta	16.250	21.79	20.81	17.87	55x14x1	pit s.b 1	42	MIDDLE TOWN	IV
568.	28086	Spheroid	Complete	Slightly Chipped	Agate	26.745	27.81	27.62	23.16	55 x 63 x 4	2	35	MIDDLE TOWN	IV
569.	52551	Spheroid	Complete	Slightly Chipped	Gabbro	27.044	27.90 - 28.53	18.93	-	35x32x4	2	30 - 40	LOWER TOWN	V
570.	17450	Spheroid	Complete	Slightly Chipped	Sandstone	62.469	36.21	30.86	-	44x44	6	110	MIDDLE TOWN	V
571.	54537	Spheroid	Complete	Slightly Chipped	Sandstone	70.000	37.47	37.38	-	38x89x9		134	EMBK.	IV
572.	50961	Spheroid	Complete	Slightly Chipped	Stone	78.115	41.78	40.61	27.38	48x87				
573.	54523	Spheroid	Complete	Slightly Chipped	Sandstone	122.720	42.46	36.60	-	55x44x3	3	38		
574.	4266	Spheroid	Complete	Slightly Chipped	Limestone	136.551	46.39	46.15	40.77	A.15/1	2	15	CASTLE	VI
575.	38897	Spheroid	Complete	Slightly Chipped	Sandstone	420.000	69.01	68.74	62.25	47x76x1	2	50	CASTLE	
576.	37950	Spheroid	Complete	Slightly Chipped	Sandstone	523.200	74.74	68.43	60.01	47x54x4	1	22	CASTLE	
577.	38664	Spheroid	Complete	Slightly Chipped	Stone	1300.000	103.59	98.38	77.30	47x74x4	3	60	CASTLE	
578.	54517	Spheroid	Complete	Slightly Chipped	Yellow limestone	1350.000	110.04	76.63	-					
579.	35039	Cuboid	Complete	Tempered, Omitted	Basalt	13.539	19.07	18.32	16.48	45 x 13 x 4	3	38	MIDDLE TOWN	V
580.	54487	Cuboid	Complete, Modified	Perfect	Siltstone	19.086	23.83	19.77	18.25					
581.	34493	Cuboid	Complete, Remodified	Chipped	Hematite	16.299	18.42	16.72	15.11	47 x 64 x 4	1	3	CASTLE	V
582.	54475	Cuboid	Complete, Remodified	Perfect	Stone	23.506	27.65	21.44	16.63	58x51x1	6a	170	BAILEY	IV
583.	44504	Cuboid	Complete, Remodified	Slightly Chipped	Limestone	22.307	26.07	25.90	17.36		9	205 - 15	CASTLE	IV
584.	12108	Domical	Natural	Perfect	Stone	8.886	21.53	20.26	13.48	25x44	11	-150		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
585.	31264	Spheroid	Natural	Perfect	Stone	2.985	16.25	9.34	-	57x10x3	1	20-30		
586.	52043	Domical	Natural	Slightly Chipped	Terracotta	10.116	28.79	28.27	12.24	47x23x2	2	35	CASTLE	
587.	54472	Domical	Natural		Sandstone	7.837	21.02	11.89	-	55x84x3	2a	45-55	MIDDLE TOWN	IV
588.	140	Domical	Natural		Stone	32.601	31.67	30.43	20.22	45x4x1	2a	62		
589.	54423	Cuboid	new	Slightly Chipped, cal.	Grey Limestone	3520.000	144.3 0 B 121.8 7 U	137.1 0 B 121.8 7 U	80.00					
590.	54499	Amorphous	Non-classical	Chipped	Basalt	13.766	23.93	22.12	13.36	45x43x2	19	3	MIDDLE TOWN	IV
591.	54416	Cylindroid	Non-classical	Chipped, Calculable	Limestone	12070.000	20.30	18.00	-	suface				
592.	54405	Discoid	Non-classical	Chipped, Calculable	Limestone	4830.000	21.00	7.30	-				LOWER TOWN	IV/V
593.	21257	Amorphous	Non-classical	Damaged, Omitted	Shell	0.484	7.45	6.56	4.66	45 x 43 x 2	20	343	MIDDLE TOWN	IV
594.	54420	Amorphous	Non-classical	Damaged, Omitted	Black stone	0.567	8.68	5.42	-					
595.	47833	Amorphous	Non-classical	Damaged, Omitted	Jasper	13.786	21.81	18.19	15.07	38 x 98 x 1 & 4	3	22		
596.	54411	Bar	Non-classical	Damaged, Omitted	Limestone	620.000	10.70	7.70	3.10	37x57x1	13	500	ER	V
597.	46608	Cuboid	Non-classical	Damaged, Omitted	Jasper	0.682	14.47	-	4.85	55 x 85 xbaulk	5	5	MIDDLE TOWN	V
598.	47339	Cuboid	Non-classical	Damaged, Omitted	Copper	1.242	10.24	10.02	6.52	35 x 73	5	102	MIDDLE TOWN	
599.	54474	Cuboid	Non-classical	Damaged, Omitted	Stone	34.034	39.09	34.43	23.63	47x7x3	5	180-186		V
600.	8572	Cuboid	Non-classical	Damaged, Omitted	Chert	48.885	42.66	-	31.31	47 x 61 x 1+2	7	250 - 70	EoC	IV
601.	37705	Cuboid	Non-classical	Damaged, Omitted	Sandstone	78.809	46.85	40.60	18.60	37x56x4	18	795	ER	IV/V
602.	19323	Cuboid	Non-classical	Damaged, Omitted	Chalcedony	80.326	37.77	32.89	34.36	45x33x3	8	124		
603.	54524	Cuboid	Non-	Damaged,	Sandstone	110.000	64.12	50.06	19.50					

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
			classical	Omitted										
604.	26545	Cylindroid	Non-classical	Damaged, Omitted	Limestone	19.867	22.62	20.20	26.24	58 x 36 x 2	1	78		
605.	54534	Cylindroid	Non-classical	Damaged, Omitted	Limestone	105.000	53.00	32.48	-					
606.	54510	Discoid	Non-classical	Damaged, Omitted	Terracotta	10.704	27.64	24.11	15.16	15x64x4	1	8	LOWER TOWN	
607.	7559	Discoid	Non-classical	Damaged, Omitted	Green stone	14.598	28.43	27.07	14.12	47x48x1	2	165	CASTLE	VI
608.	35961	Hemispheroi	Non-classical	Damaged, Omitted	Sandstone	88.605	48.33	28.08	-	47x74x4	5	135	CASTLE	
609.	54540	Hemispheroi	Non-classical	Damaged, Omitted	Sandstone	170.000	58.88	44.98						
610.	54521	Pebble	Non-classical	Damaged, Omitted	Stone	120.000	56.31	40.00	-	47x89x3	1			
611.	54428	Pebble	Non-classical	Damaged, Omitted	Stone	220.000	60.23	40.25	-	47x35x2	1		CASTLE	VI
612.	18258	Pebble	Non-classical	Damaged, Omitted	Sandstone	224.284	60.54	41.48	-	44x44x2	15	222		
613.	54500	Spheroid	Non-classical	Damaged, Omitted	Sandstone	38.539	30.57	29.65	26.19	55x14x1	6	108	MIDDLE TOWN	IV
614.	33916	Tabloid	Non-classical	Damaged, Omitted	Terracotta	1.439	14.40	12.72	7.17	45 x 3 x 3	2	41-45	MIDDLE TOWN	V
615.	51375	Tabloid	Non-classical	Damaged, Omitted	Sandstone	6.942	28.23	19.01	9.48	surface	surfac e		MIDDLE TOWN	IV/V
616.	53960	Tabloid	Non-classical	Damaged, Omitted	Sandstone	12.905	32.93	22.02	11.91	47x74x4	19	375	MIDDLE TOWN	IV
617.	53932	Tabloid	Non-classical	Damaged, Omitted	Sandstone	16.067	20.09	13.02	40.61		19	372	CASTLE	IV
618.	53991	Tabloid	Non-classical	Damaged, Omitted	Ernestite	16.433	37.30	26.07	7.29	55x79x2	4	110	MIDDLE TOWN	IV
619.	53902	Tabloid	Non-classical	Damaged, Omitted	Sandstone	21.497	35.23	22.64	17.44	47x74x4	18	370	CASTLE	IV
620.	19658	Amorphous	Non-classical	Perfect	Shell	0.326	6.75	5.39	4.65	25x74x2				
621.	54555	Amorphous	Non-classical	Perfect	Shell	0.336	6.12	5.97	4.45	35x53x4	1	65		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
622.	6	Amorphous	Non-classical	Perfect	Shell	0.372	7.44	-	5.08	58x55x3	3			
623.	14559	Amorphous	Non-classical	Perfect	Shell	0.460	9.83	8.39	2.49	48x42x1	4	80		
624.	19486	Amorphous	Non-classical	Perfect	Shell	0.531	9.89	8.02	7.67	57x60x1	1d	88		
625.	36736	Amorphous	Non-classical	Perfect	Shell	0.558	10.72	8.92	3.19	47x55x3	2	22	CASTLE	
626.	24683	Amorphous	Non-classical	Perfect	Shell	0.559	8.96	4.01	-	57x47x3		183-253		
627.	11889	Amorphous	Non-classical	Perfect	Shell	0.591	10.03	7.76	3.77	55x44x4	3	70		
628.	30977	Amorphous	Non-classical	Perfect	Shell	0.704	7.45	7.37	7.25	47x57x2&3	3	105		
629.	46091	Amorphous	Non-classical	Perfect	Agate	0.715	13.33	6.77	4.51	46x61x3	38	518-22	LOWER TOWN	V
630.	32423	Amorphous	Non-classical	Perfect	Shell	0.790	8.34	7.95	5.29	55x83x2	1	28		
631.	14996	Amorphous	Non-classical	Perfect	Shell	0.858	7.96	7.58	-	48x43x4	2	-60		
632.	21810	Amorphous	Non-classical	Perfect	Shell	0.883	7.54	7.36	7.20	58 x 54 x 4	3	205	BAILEY	IV
633.	22992	Amorphous	Non-classical	Perfect	Shell	0.995	9.97	8.09	5.62	57 x 57 x2	24	415	BAILEY	
634.	54560	Amorphous	Non-classical	Perfect	Shell	0.998	11.96	8.56	4.72	35x3x4	1	75	LOWER TOWN	
635.	25404	Amorphous	Non-classical	Perfect	Terracotta	1.015	10.31	8.68	-	23x10x2	pit-1 s/b 2	150		
636.	43485	Amorphous	Non-classical	Perfect	Shell	1.036	10.51	9.01	4.73	55x88x2	1	35	MIDDLE TOWN	
637.	19038	Amorphous	Non-classical	Perfect	Shell	1.052	10.13	8.31	6.47	57x56x4	3	39		
638.	45021	Amorphous	Non-classical	Perfect	Shell	1.102	10.49	9.74	5.24	55x87x4	3	61	MIDDLE TOWN	
639.	54558	Amorphous	Non-classical	Perfect	Shell	1.119	14.03	7.35	5.10	25x5x1	3	64		
640.	27237	Amorphous	Non-classical	Perfect	Shell	1.302	12.90	9.37	5.04	45x44	surface			

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
641.	31481	Amorphous	Non-classical	Perfect	Shell	1.357	16.36	8.85	5.70	47x67x2	3	115		
642.	24079	Amorphous	Non-classical	Perfect	Terracotta	1.419	14.52	11.41	8.27	37x34x4	6	260		
643.	26854	Amorphous	Non-classical	Perfect	Shell	1.501	13.35	7.19-.22	-	47x79x3+4	3	60-70		
644.	54494	Amorphous	Non-classical	Perfect	Stone	1.704	7.64	6.74	16.77					
645.	21948	Amorphous	Non-classical	Perfect	Shell	1.779	14.60	11.37	5.20	25x1x2	1	5	LOWER TOWN	
646.	19470	Amorphous	Non-classical	Perfect	Shell	1.786	12.68	10.70	6.76	58x53x3	4	210		
647.	10812	Amorphous	Non-classical	Perfect	Shell	1.820	16.32	10.88	5.73	45x94x3	pit s/b 1	65		
648.	23586	Amorphous	Non-classical	Perfect	Shell	1.821	14.51	9.89	5.65	28x8x1	3	104		
649.	16535	Amorphous	Non-classical	Perfect	Shell	1.873	11.32	10.97	7.02	55x51x1	2	20		
650.	13293	Amorphous	Non-classical	Perfect	Shell	1.874	14.26	10.85	5.77	57x20x2	6	175		
651.	14555	Amorphous	Non-classical	Perfect	Shell	1.910	16.85	14.76	3.98	48x41x2	1	23		
652.	23979	Amorphous	Non-classical	Perfect	Shell	1.925	16.39	10.76	7.75	47x18x1	6	135		
653.	19478	Amorphous	Non-classical	Perfect	Shell	1.926	14.17	9.91	6.08	54x58x1	3	-26		
654.	48257	Amorphous	Non-classical	Perfect	Shell	1.930	12.13	-	7.53	35x52x4	1	110	MIDDLE TOWN	
655.	42852	Amorphous	Non-classical	Perfect	Shell	1.991	10.41	-	9.75	47x96x2	3	94	CASTLE	
656.	29493	Amorphous	Non-classical	Perfect	Shell	2.004	14.07	10.78	5.56	66x55x1	7	156		
657.	42225	Amorphous	Non-classical	Perfect	Shell	3.076	13.15	13.22	10.04	47x56x2	2	87	CASTLE	V
658.	16722	Amorphous	Non-classical	Perfect	Shell	3.092	12.38	11.22	-	56 x 54 x 3	2	90	MIDDLE TOWN	V
659.	15107	Amorphous	Non-classical	Perfect	Shell	3.256	13.58	13.21	10.69	56x55x1	1	130		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
660.	19965	Amorphous	Non-classical	Perfect	Shell	3.406	15.24	13.79	8.85	57x54x1	5	135	CASTLE	
661.	16859	Amorphous	Non-classical	Perfect	Agate	3.503	19.87	10.30	9.41	47 x 7 x 3	9 B	422	CASTLE	IV
662.	44136	Amorphous	Non-classical	Perfect	Quartz	3.531	13.93	12.67	9.66	55x77xBaulk	2	40	MIDDLE TOWN	IV
663.	35673	Amorphous	Non-classical	Perfect	Chert	4.304	19.94	9.50	8.83	15x14x4	2	50	MIDDLE TOWN	
664.	39886	Amorphous	Non-classical	Perfect	Stone	4.440	10.79	8.30	22.67	47x79x2	1	74	CASTLE	VI
665.	14729	Amorphous	Non-classical	Perfect	Shell	4.723	19.79	15.77	7.35	65x64x3	2	68		
666.	25336	Amorphous	Non-classical	Perfect	Shell	5.784	16.00	14.80	11.30	23 x 10 x 3	3	107	LOWER TOWN	IV/V
667.	16405	Amorphous	Non-classical	Perfect	Shell	6.757	28.99	14.41	7.05	56x55x4	2 R-8	130		
668.	52313	Amorphous	Non-classical	Perfect	Shell	7.049	19.07	15.76	13.39	35x32x4	1	Oct-25	LOWER TOWN	
669.	10338	Bar	Non-classical	Perfect	Shell	1.179	12.25	7.73	5.87	57x18x1	4	149		
670.	37309	Bar	Non-classical	Perfect	Chert	1.262	15.86	7.10	6.84	47x75x3	4	60	CASTLE	
671.	10302	Bar	Non-classical	Perfect	Shell	1.497	11.53	6.54	-	55 x 4 x 3	2	38	CASTLE	V
672.	47121	Bar	Non-classical	Perfect	Sandstone	3.431	16.27	10.62	9.65	35 x 52 x 2	3	60	MIDDLE TOWN	V
673.	34092 b	Bar	Non-classical	Perfect	Shell	4.655	26.20	8.89	8.29	47x85x1	1	20	CASTLE	
674.	54505	Bar	Non-classical	Perfect	Sandstone	13.729	33.95	14.44	12.06	55x84x2	3	35		
675.	5846	Bar	Non-classical	Perfect	Stone	27.278	35.35	18.74	16.50	58x2x3	MBR 1B pit 1	362	CASTLE	IV/V
676.	9203	Bar	Non-classical	Perfect	Sandstone	29.332	41.26	19.71	19.28	45x94	1	14		
677.	19523	Conical	Non-classical	Perfect	Pottery	3.642	16.84	16.10	12.28	57 x 57 x 2	4 a	157	MIDDLE TOWN	IV
678.	30109	Cuboid	Non-	Perfect	Shell	0.565	9.68	6.94	4.65	65x3x2	1	40	MIDDLE TOWN	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
			classical											
679.	22787	Cuboid	Non-classical	Perfect	Shell	0.664	9.35	7.87	4.09	24x9x2	7	-88		
680.	26348	Cuboid	Non-classical	Perfect	Shell	0.771	8.84	8.53	4.53	57x55x2				
681.	54557	Cuboid	Non-classical	Perfect	Shell	1.193	10.2	9.45	5.69	54x60x20	3	16- (-5)		
682.	26852	Cuboid	Non-classical	Perfect	Terracotta	1.697	14.47	13.31	5.86	37x75x1	5	275		
683.	22188	Cuboid	Non-classical	Perfect	Sandstone	6.298	20.32	19.70	10.99	25 x 7 x 4	2	55	LOWER TOWN	V
684.	37226	Cuboid	Non-classical	Perfect	Sandstone	26.979	37.22	28.54	18.38	37x56x4	16	672	ER	IV/V
685.	12248	Cuboid	Non-classical	Perfect	Stone	57.402	33.47	33.67	27.87	55x54x2	2	12		
686.	6535	Cuboid	Non-classical	Perfect	Stone	59.640	42.93	33.22	27.91	57x5x1	2	10-15	CASTLE	V
687.	47867	Cuboid	Non-classical	Perfect	Sandstone	66.192	37.62	34.25	26.32	48 x 88	4	170		IV/V
688.	40444	Cuboid	Non-classical	Perfect	Sandstone	87.895	48.80	40.95	32.28	45x70x3	1	35	MIDDLE TOWN	IV
689.	20884	Cylindroid	Non-classical	Perfect	Shell	0.635	6.85	-	7.43	58x54x3&58 x55x4	erosio n	222		
690.	21055	Cylindroid	Non-classical	Perfect	Shell	0.888	8.29		7.81	58x54x3, 58x55x4	5c	225		
691.	3712	Cylindroid	Non-classical	Perfect	Shell	1.007	10.42	7.31-6.39	-	A 18/1	10+1 1			
692.	20085	Cylindroid	Non-classical	Perfect	Shell	3.503	11.73	10.88	14.12	45 x 43 x 2	6	89	MIDDLE TOWN	IV
693.	29637	Cylindroid	Non-classical	Perfect	Shell	7.108	16.87	13.24	-	37x74x3	2	10		
694.	30727	Cylindroid	Non-classical	Perfect	Shell	10.246	18.59	18.43	16.81	66x54x1	2	24		
695.	54542	Discoid	Non-classical	Perfect	Shell	0.07	6.31	-	1.11	45/54	5	82		
696.	54419	Discoid	Non-classical	Perfect	Shell	0.083	6.86	-	1.21	45 x 84 x 1	3	54	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
697.	16340	Discoid	Non-classical	Perfect	Shell	0.127	6.91	-	1.74					
698.	54543	Discoid	Non-classical	Perfect	Shell	0.132	7.11	-	1.80	55x76/1	2	14		
699.	37720	Discoid	Non-classical	Perfect	Shell	0.279	10.17	-	1.84					
700.	35376	Discoid	Non-classical	Perfect	Copper	0.294	5.87	2.26	-	45 x 3 x 3	unstr atified	-	MIDDLE TOWN	
701.	54544	Discoid	Non-classical	Perfect	Shell	0.510	12.42	-	2.53	55x88x2	2	40	MIDDLE TOWN	
702.	49997	Discoid	Non-classical	Perfect	Sandstone	1.265	12.17	7.20	-	r-8 47x84x2		130	CASTLE	
703.	54431	Discoid	Non-classical	Perfect	Sandstone	145.000	-	-	-					
704.	54502	Domical	Non-classical	Perfect	Quartz	13.852	20.30	20.10	24.70	55x94x3	2	12	MIDDLE TOWN	
705.	28555	Lentoid (beady)	Non-classical	Perfect	Shell	1.209	10.90	10.32	6.16	55x94x1+4	Baulk remo ving			
706.	16615	Lentoid (beady)	Non-classical	Perfect	Shell	1.735	13.04	11.96	5.31	58x31x2, 3	debri	550		
707.	24888	Lentoid (beady)	Non-classical	Perfect	Shell	1.840	12.56	11.68	6.93	47x88x2&3	Baulk remo ving			
708.	390	Lentoid (beady)	Non-classical	Perfect	Shell	2.720	15.60	13.74	5.83	B.19/1	1	5		
709.	54558	Ovate	Non-classical	Perfect	Shell	1.634	16.30	11.41	4.45	25x54x3	2	22		
710.	38006	Ovate	Non-classical	Perfect	Agate	1.875	14.39	11.19	6.80	45x73x1	3	33	MIDDLE TOWN	
711.	44895	Ovate	Non-classical	Perfect	Shell	1.945	18.53	10.36	4.80	35x13x4	1	70	LOWER TOWN	
712.	33139	Ovate	Non-classical	Perfect	Stone	2.083	15.32	11.42	6.45	47x88x3	8, 9	250 - 40	CASTLE	IV
713.	28032	Pebble	Non-classical	Perfect	Stone	136.211	44.01	43.17	43.44	55x63x4	1	15	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
714.	54452	Pebble	Non-classical	Perfect	Stone	196.555	67.51	38.74	-					
715.	54528	Pebble	Non-classical	Perfect	sansstone	346.782	65.05	60.10	59.53	47x74x3	3	45	CASTLE	
716.	54440	Pebble	Non-classical	Perfect	Stone	400.000	63.91	59.65	-	47x84x1	9	140	CASTLE	V
717.	54434	Pebble	Non-classical	Perfect	Stone	410.000	69.94	58.62	-	47x84x1	5	147 - 49	CASTLE	V
718.	14498	Plano-convex	Non-classical	Perfect	Shell	44.518	31.67	27.71	23.45	48x92x2	2	30	CASTLE	VI
719.	47877	Pyramidal	Non-classical	Perfect	Terracotta	0.571	-	-	-	47x63x2&3	pit-1 s/b 18	323	CASTLE	
720.	43184	Pyramidal	Non-classical	Perfect	Chalcedony	1.911	-	-	-	55x75x4	2	56	MIDDLE TOWN	
721.	44527	Pyramidal	Non-classical	Perfect	Sandstone	2.299	-	-	-	45x68x1	2	31	MIDDLE TOWN	V
722.	10350	Pyramidal	Non-classical	Perfect	Stone	3.282	-	-	-	45x14x2	2	15-75	MIDDLE TOWN	V
723.	25277	Pyramidal	Non-classical	Perfect	Terracotta	3.299	-	-	-	23x8x2	2	29		
724.	40436	Pyramidal	Non-classical	Perfect	Yellow limestone	7.252	-	-	-	55x75x1	dump	25	MIDDLE TOWN	IV/V
725.	40435	Pyramidal	Non-classical	Perfect	Yellow limestone	7.261	-	-	-	55x75x1	unstr atified	26	MIDDLE TOWN	IV/V
726.	54520	Pyramidal	Non-classical	Perfect	Stone	7.692	19.19	18.05	16.46	57x60x2	2	81		
727.	38187	Pyramidal	Non-classical	Perfect	Black stone	9.053	24.31	24.31	24.31	47 x 74	10	190	CASTLE	IV
728.	18317	Pyramidal	Non-classical	Perfect	Sandstone	18.103	25.33	20.00	34.03	57 x 57 x 3	1	54		
729.	54496	Pyramidal	Non-classical	Perfect	Sandstone	51.046	-	-	-					
730.	18008	Spheroid	Non-classical	Perfect	Agate	3.688	17.34	14.10	10.40	surface			MIDDLE TOWN	
731.	37604	Spheroid	Non-classical	Perfect	Shell	26.679	26.16	25.62	22.80	35x63x4	3	27		
732.	18572	Tabloid	Non-classical	Perfect	Shell	0.621	12.10	8.31	2.77	45x33x3	4	52		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
733.	3175	Tabloid	Non-classical	Perfect	Shell	0.630	12.48	-	2.69					
734.	29349	Tabloid	Non-classical	Perfect	Agate	0.898	12.85	7.49	4.44	66x55x2	1	8		
735.	1316	Tabloid	Non-classical	Perfect	Shell	0.940	11.16	9.37	4.35	A-19/2	1			
736.	18827	Tabloid	Non-classical	Perfect	Shell	1.018	9.92	9.83	4.13	58x54x1	2	91		
737.	49921	Tabloid	Non-classical	Perfect	Terracotta	1.287	14.44	-	5.59	37x76x3	3	12		
738.	40617	Tabloid	Non-classical	Perfect	Terracotta	1.710	9.70	9.34	6.87	48x98	6	270		
739.	41881	Tabloid	Non-classical	Perfect	Terracotta	2.200	14.61	13.46	9.42	45x63x4	2	70	MIDDLE TOWN	V
740.	18110	Tabloid	Non-classical	Perfect	Agate	2.269	13.05	12.85	6.07	47x98x2	3b	282	CASTLE	IV
741.	23040	Tabloid	Non-classical	Perfect	Terracotta	2.800	16.54	7.86	-	25x9x2	2	105		
742.	9528	Tabloid	Non-classical	Perfect	Shell	2.861	20.95	17.26	3.92	45 x 14 x 1	4	84	MIDDLE TOWN	IV/V
743.	9508	Tabloid	Non-classical	Perfect	Steatite	2.896	14.20	14.12	7.14	45x34x4	pit s/b 2	40		
744.	54503	Tabloid	Non-classical	Perfect	Stone	3.142	3.14	-	-	58x54x3	5	128		
745.	54509	Tabloid	Non-classical	Perfect	Terracotta	4.259	19.15	9.17	-	44x43x2/3	4	20	MIDDLE TOWN	
746.	22309	Tabloid	Non-classical	Perfect	Terracotta	4.487	19.21	11.74	12.35	37 x 49 x 4	1 b	228	ER	VI
747.	8013	Tabloid	Non-classical	Perfect	Sandstone	4.520	23.74	21.93	6.24	48x1x1	1	5-10		
748.	23877	Tabloid	Non-classical	Perfect	Stone	5.812	25.74	20.34	7.51	24x3x3	12:00 am	33	LOWER TOWN	IV
749.	718	Tabloid	Non-classical	Perfect	Shell	6.313	24.84	16.85	6.60	D-19/2	3	112-18		
750.	33706	Tabloid	Non-classical	Perfect	Sandstone	6.576	21.94	19.65	10.10	35 x 73 x 2	2	0	MIDDLE TOWN	V
751.	23344	Tabloid	Non-classical	Perfect	Terracotta	6.800	23.17	22.05	11.26	25 x 7 x 3	4	157	LOWER TOWN	IV

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
752.	25365	Tabloid	Non-classical	Perfect	Sandstone	7.605	31.61	15.59	10.20	23x10x2	pit-1 s/b 2	115		
753.	8144	Tabloid	Non-classical	Perfect	Sandstone	8.412	35.30	20.17	6.94	48x92x4	pit a s/b 31	730		
754.	19761	Tabloid	Non-classical	Perfect	Terracotta	9.100	24.85	22.74	10.68	35 x 33 1	1	18	LOWER TOWN	V
755.	18583	Tabloid	Non-classical	Perfect	Terracotta	11.200	31.26	27.82	7.55	45 x 33 x 3	4	46	MIDDLE TOWN	V
756.	16147	Tabloid	Non-classical	Perfect	Sandstone	12.758	31.93	20.08	12.82	48x41x1	2	70	CASTLE	VI
757.	17681	Tabloid	Non-classical	Perfect	Sandstone	13.776	20.00	19.01	18.12					
758.	44435	Tabloid	Non-classical	Perfect	Sandstone	15.640	36.25	22.67	10.36	46 x 71 x 3	6	173-84	MIDDLE TOWN	IV
759.	53896	Tabloid	Non-classical	Perfect	Sandstone	17.826	32.75	28.13	11.72	47x74x4	18	370	CASTLE	VI
760.	556	Tabloid	Non-classical	Perfect	Gabbro	27.364	32.21	29.08	12.38	C.19/1	1	10	CASTLE	V/VI
761.	35267	Tabloid	Non-classical	Perfect	Sandstone	29.023	40.02	35.57	11.40	37x56x4	8	200		
762.	17543	Tabloid	Non-classical	Perfect	Sandstone	42.471	50.20	41.15	13.66	56x54x3	6	160		
763.	45828	Trapezoidal	Non-classical	Perfect	Sandstone	7.639	20.04	14.76	15.58	55x89x2	2	33	MIDDLE TOWN	V
764.	5999	Trapezoidal	Non-classical	Perfect	Sandstone	15.585	29.06	21.94	13.60	48x92x3+4	32	585-600		
765.	22014	Amorphous	Non-classical	Partly Chipped	Sandstone	180.000	78.27	76.65	25.11	57x60x2	2	42	BAILEY	VI
766.	54429	Amorphous	Non-classical	Partly Chipped	Sandstone	210.000	73.61	22.22	-	25x83x1	1	9	LOWER TOWN	V
767.	54536	Amorphous	Non-classical	Partly Chipped	Limestone	315.000	76.87	68.03	36.99					
768.	54410	Amorphous	Non-classical	Partly Chipped	Sandstone	330.000	8.50	2.80	-	57x57x2				
769.	45743	Amorphous	Non-classical	Slightly Chipped	Shell	0.474	1.00	2.47	-	46x61x3	32	455-60	CASTLE	VI
770.	20103	Amorphous	Non-classical	Slightly Chipped	Shell	0.606	7.44	5.16		57x43x1	1	7		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
771.	24737	Amorphous	Non-classical	Slightly Chipped	Shell	0.670	9.82	7.28	5.25	57x47x3 & 57x51x2	19 to 26	290		
772.	18581	Amorphous	Non-classical	Slightly Chipped	Shell	1.982	14.02	10.43	8.05	57x60x4	1	35		
773.	45714	Amorphous	Non-classical	Slightly Chipped	Tablet	1.997	14.36	11.88	6.58	47x95x1	12	275	CASTLE	
774.	15550	Amorphous	Non-classical	Slightly Chipped	Shell	2.582	14.23	7.46	-	35x53x4	pit s/b 2	80		
775.	33951	Amorphous	Non-classical	Slightly Chipped	Shell	2.834	11.81	11.41	13.11	47x84x4	1	45	CASTLE	
776.	23219	Bar	Non-classical	Slightly Chipped	Shell	13.541	26.45	16.22	13.82	54x67x3	5	112	MIDDLE TOWN	
777.	24651	Bar	Non-classical	Slightly Chipped	Stone	78.170	60.25	34.81	26.05	48x48x1	2	106		
778.	1817	Cuboid	Non-classical	Slightly Chipped	Terracotta	6.038	24.01	16.71	10.81	F 19	6	210-20	CASTLE	IV
779.	54485	Cuboid	Non-classical	Slightly Chipped	Sandstone	13.404	22.55	20.57	15.87	45x33x3	9	129-140	MIDDLE TOWN	IV
780.	22550	Cuboid	Non-classical	Slightly Chipped	Sandstone	13.473	22.28	20.40	21.08	24x7x3	2	3		
781.	50599	Cuboid	Non-classical	Slightly Chipped	Sandstone	28.704	30.23	29.93	20.39	37x78x2	1	38	EoC	VI
782.	25977	Cuboid	Non-classical	Slightly Chipped	Sandstone	96.201	57.65	31.04	25.40	25x5x2	15	164-69		
783.	38663	Cuboid	Non-classical	Slightly Chipped	Sandstone	238.153	80.92	57.89	30.91	45x3x3	21	446	MIDDLE TOWN	IV
784.	24334	Cylindroid	Non-classical	Slightly Chipped	Terracotta	2.000	13.31 -.66	10.03	-	59 x x12 x 4	5	90	BAILEY	IV
785.	54476	Cylindroid	Non-classical	Slightly Chipped	Stone	3.928	18.57	17.91	11.72	25x9x1	2	49	LOWER TOWN	V
786.	53063	Cylindroid	Non-classical	Slightly Chipped	Terracotta	6.130	20.66	20.42	12.22	47x61x3	7	335	CASTLE	IV
787.	6763	Cylindroid	Non-classical	Slightly Chipped	Stone	17.146	18.73	14.61	31.03	57x5x2	2	88	BAILEY	V
788.	13474	Cylindroid	Non-classical	Slightly Chipped	Stone	71.133	40.80	35.73	29.92	15x24x1	2	15	LOWER TOWN	V
789.	36927	Discoid	Non-classical	Slightly Chipped	Terracotta	2.600	15.06 -.22	9.85	-	35x x63 x 3	2	4	MIDDLE TOWN	V

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
790.	33887	Discoid	Non-classical	Slightly Chipped	Terracotta	7.241	28.89	7.49	-	35x73x3	3	30		
791.	46988	Discoid	Non-classical	Slightly Chipped	Shell	11.702	22.90	11.27	-	47x84x2	surface	132		
792.	46825	Ovate	Non-classical	Slightly Chipped	Shell	2.018	18.48	12.94	5.34	47x84x1	1 baulk	70	CASTLE	
793.	54426	Pebble	Non-classical	Slightly Chipped	Basalt	100.000	44.56	37.92	-	58x18x3	4	208		
794.	51970	Pebble	Non-classical	Slightly Chipped	Sandstone	111.648	51.51	49.85	34.59	58x39x4	4	105		
795.	48913	Pebble	Non-classical	Slightly Chipped	Sandstone	115.468	75.56	39.41	-	48x18	9	540	SR-3	IV/V
796.	22671	Pebble	Non-classical	Slightly Chipped	Sandstone	136.931	44.08	43.97	41.06	118x34x4	surface	130	CEMETERY	
797.	54449	Pebble	Non-classical	Slightly Chipped	Stone	199.099	53.07	44.35	-	38x83x2	1	100	EMBK.	IV
798.	54430	Pebble	Non-classical	Slightly Chipped	Stone	210.000	61.40	37.38	-					
799.	54415	Pebble	Non-classical	Slightly Chipped	Limestone	220.000	4.00	2.80	-	47x35x4	1	surface	CASTLE	VI
800.	54528 a	Pebble	Non-classical	Slightly Chipped	sansstone	226.196	55.78	50.89	48.25	47x74x3	3	45	CASTLE	
801.	54538	Pebble	Non-classical	Slightly Chipped	Chert	250.000	64.40	50.22	-					
802.	54436	Pebble	Non-classical	Slightly Chipped	Stone	250.000	57.96	50.29	-	25x93x2	1a	8	LOWER TOWN	V
803.	54439	Pebble	Non-classical	Slightly Chipped	Stone	250.000	63.08	57.68	49.74	57x34x4	1	69	BAILEY	VI
804.	45799	Pebble	Non-classical	Slightly Chipped	Sandstone	262.748	58.53	56.56	43.70	58x18, 19	9	435		
805.	54433	Pebble	Non-classical	Slightly Chipped	Limestone	285.000	73.70	40.03	-	109x15x64	3	60 - 75	CEMETERY	
806.	22007	Pebble	Non-classical	Slightly Chipped	Stone	290.000	63.86	48.39	-	57x53x4	1	7	BAILEY	VI
807.	54528 b	Pebble	Non-classical	Slightly Chipped	Sandstone	295.410	66.14	59.35	56.39	47x76x1	2	50	CASTLE	
808.	54442	Pebble	Non-	Slightly Chipped	Stone	297.206	68.53	42.08	-	47x73x2	1	16		VI

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
			classical											
809.	54532	Pebble	Non-classical	Slightly Chipped	sansstone	318.788	63.29	56.20	51.91	47x74x3	3	55	CASTLE	
810.	54535	Pebble	Non-classical	Slightly Chipped	Sandstone	320.000	66.81	52.81	-					
811.	24946	Pebble	Non-classical	Slightly Chipped	Stone	320.000	69.59	51.09	-	47x17x4	3	78	CASTLE	VI
812.	54448	Pebble	Non-classical	Slightly Chipped	Stone	326.439	66.66	58.00	-	room no-3 47x84x1	5	147 - 49	CASTLE	IV
813.	54438	Pebble	Non-classical	Slightly Chipped	Sandstone	360.000	70.18	47.43	-	57x56x2	1	52	BAILEY	VI
814.	54430	Pebble	Non-classical	Slightly Chipped	Black stone	362.356	65.25	61.54	53.34	47x74x3	3	55	CASTLE	
815.	54445	Pebble	Non-classical	Slightly Chipped	Sandstone	364.335	71.20	64.88	50.52	46x64x1			MIDDLE TOWN	
816.	54441	Pebble	Non-classical	Slightly Chipped	Stone	393.465	72.30	52.63	-	35x73	13	182	MIDDLE TOWN	IV
817.	37941	Pebble	Non-classical	Slightly Chipped	Sandstone	400.000	78.82	66.19	53.03	45x13x4	2	19	MIDDLE TOWN	V
818.	54454	Pebble	Non-classical	Slightly Chipped	Sandstone	400.000	69.51	57.33	-					
819.	54427	Pebble	Non-classical	Slightly Chipped	Quartzite	405.000	63.06	63.84	-	57x54x1	3b	70 - 78	BAILEY	VI
820.	54526	Pebble	Non-classical	Slightly Chipped	Siltstone	440.000	65.82	63.37	58.72	47x76x1	2	50	CASTLE	
821.	54533	Pebble	Non-classical	Slightly Chipped	Sandstone	450.000	68.99	67.07	58.62	47x76x3	3	45	CASTLE	
822.	54525	Pebble	Non-classical	Slightly Chipped	Sandstone	490.000	70.19	69.13	65.61	47x76x1	2	50	CASTLE	
823.	54453	Pebble	Non-classical	Slightly Chipped	Sandstone	490.000	75.58	66.21	-	55x54	1	22		
824.	38665	Pebble	Non-classical	Slightly Chipped	Sandstone	530.000	77.81	74.49	59.88	47x74x4	3	60	CASTLE	
825.	54435	Pebble	Non-classical	Slightly Chipped	Sandstone	610.000	82.41	76.39	75.06	37x49x2	1a	39	ER	VI
826.	54541	Pebble	Non-classical	Slightly Chipped	Sandstone	770.000	82.35	80.42	59.03	57x69x1	2	20		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
827.	54527	Pebble	Non-classical	Slightly Chipped	Sandstone	830.000	82.99	78.30	80.70	47x76x1	2	50	CASTLE	
828.	27405	Pyramidal	Non-classical	Slightly Chipped	Terracotta	6.114	14.69	14.62	19.60	47x35x3		175		
829.	11069	Spheroid	Non-classical	Slightly Chipped	Shell	2.288	12.32	8.77	-	45 x 94	2	38	MIDDLE TOWN	V
830.	39676	Spheroid	Non-classical	Slightly Chipped	Pottery	2.496	14.37	10.94	-	35x83x1+2	5	163	MIDDLE TOWN	IV
831.	6975	Spheroid	Non-classical	Slightly Chipped	Pottery	5.800	18.50	17.70	15.98	57 x 5 x 2	9 a	165	CASTLE	IV
832.	54455	Spheroid	Non-classical	Slightly Chipped	Stone	350.000	60.14	64.19	-					
833.	54492	Spheroid	Non-classical	Slightly Chipped	Limestone	580.000	84.54	83.20	54.47	surface				
834.	47940	Tabloid	Non-classical	Slightly Chipped	Terracotta	0.699	12.77	-	4.55	47x63x2&3	pit-1 s/b 18	347	CASTLE	
835.	15628	Tabloid	Non-classical	Slightly Chipped	Terracotta	0.944	14.80	13.90	3.92	15x34x4	3a	112		
836.	29678	Tabloid	Non-classical	Slightly Chipped	Shell	1.803	12.92	11.40	5.39	55x83x1	2	65		
837.	42252	Tabloid	Non-classical	Slightly Chipped	Terracotta	1.970	16.54	15.19	7.21	45x70x2	1	92		
838.	34923	Tabloid	Non-classical	Slightly Chipped	Steatite	3.148	18.11	16.13	9.16	45x13x4	s.b 1			
839.	54508	Tabloid	Non-classical	Slightly Chipped	Pottery	3.311	20.36	19.7	7.26	45x45x4	2	54		
840.	24508	Tabloid	Non-classical	Slightly Chipped	Terracotta	3.500	16.68	16.12	10.70	47 x 88 x 2	7 b	212 - 24	CASTLE	IV
841.	31149	Tabloid	Non-classical	Slightly Chipped	Shell	3.992	14.75	14.45	9.47	66x54x4	3	52		
842.	19677	Tabloid	Non-classical	Slightly Chipped	Terracotta	6.700	23.84	13.74	8.88	45 x 33 x 4	2	16	MIDDLE TOWN	V
843.	49895	Tabloid	Non-classical	Slightly Chipped	Terracotta	10.800	26.63	25.39	10.24	47x23x3	2	120	CASTLE	V
844.	44116	Tabloid	Non-classical	Slightly Chipped	Sandstone	12.205	35.31	16.36	13.80		unstratified		LOWER TOWN	
845.	5466	Tabloid	Non-classical	Slightly Chipped	Stone	12.293	29.84	29.58	10.38	48x82x3+4	2	57-70		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
846.	47784	Tabloid	Non-classical	Slightly Chipped	Sandstone	13.200	29.80	20.43	14.00	35 x 42 x 4	1	100	LOWER TOWN	
847.	53940	Tabloid	Non-classical	Slightly Chipped	Sandstone	16.879	35.59	25.55	11.16	47x74x4	19	372	CASTLE	IV
848.	54507	Tabloid	Non-classical	Slightly Chipped	Sandstone	17.502	20.63	12.90	39.22	35x94x2	2a	55	MIDDLE TOWN	V
849.	37013	Tabloid	Non-classical	Slightly Chipped	Stone	23.675	34.11	31.51	15.87	45x53x1	2	13-18		
850.	13451	Tabloid	Non-classical	Slightly Chipped	Siltstone	43.931	49.93	33.96	10.84	5x64x1	1	18		
851.	37806	Tabloid	Non-classical	Slightly Chipped	Sandstone	55.334	52.62	50.31	13.41	47x75x1	3	68	CASTLE	V
852.	19914	Tabloid	Non-classical	Slightly Chipped	Sandstone	59.033	25.04	22.25	43.40	25x63x3	1	20	LOWER TOWN	V
853.	45122	Tabloid	Non-classical	Slightly Chipped	Sandstone	66.541	60.21	39.50	15.73	48 x 98 x 99	2	139		VI
854.	24536	Amorphous	Non-classical		Shell	2.518	20.64	10.98	5.93	54x86x2	5	10	MIDDLE TOWN	
855.	47801	Tabloid	Non-classical		Terracotta	1.916	15.02	7.34	-	47x94x4	2	60		
856.	53075	Tabloid	Non-classical		Terracotta	2.200	17.30	16.12	7.18	47 x 84 x 1	12	370	CASTLE	IV
857.	25179	Tabloid	Non-classical		Terracotta	2.993	20.41	18.98	6.73	23x9x2	1	55		
858.	34567	Cuboid	Sub-classical	Chipped	Sandstone	21.300	27.45	23.50	19.97	47x64x4	2	4	CASTLE	VI
859.	8181	Cuboid	Sub-classical	Chipped	Sandstone	23.423	31.55	23.50	20.21	48x1x1	1	25		
860.	38118	Cuboid	Sub-classical	Chipped	Sandstone	29.625	41.45	27.93	16.47	46x54x1	2	83		
861.	34175	Cuboid	Sub-classical	Chipped	Stone	41.800	41.62	35.84	15.90	35x63x4	4	51	MIDDLE TOWN	V
862.	43187	Spheroid	Sub-classical	Chipped	Stone	13.881	21.89	21.23	11.80	47x75x2	surface		CASTLE	VI
863.	52303	Cuboid	Sub-classical	Chipped	Sandstone	1.034	7.92	7.74	8.09	35x32x4	1	24	LOWER TOWN	V
864.	54399	Amorphous	Sub-classical	Chipped, Calculable	Limestone	4050.000	14.90	9.80	-	48x72xR-3N	1	+10 - +5	CASTLE	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
865.	54402	Cuboid	Sub-classical	Chipped, Calculable	Sandstone	3860.000	8.50	16.90	-	47x17x1	2	85	CASTLE	VI
866.	54403	Spheroid	Sub-classical	Chipped, Calculable	Limestone	5690.000	20.20	12.00	-	57x10x4	3	25	CASTLE	VI
867.	15293 b	Cuboid	Sub-classical	Damaged, Omitted	Brown stone	5.336	16.92	12.61	9.73	48x42x4	1	24		
868.	19813	Cuboid	Sub-classical	Damaged, Omitted	Stone	7.016	15.04	15.01	17.48	57x57x2	4b	198	BAILEY	IV
869.	32846	Cuboid	Sub-classical	Damaged, Omitted	Black stone	10.629	17.75	16.35	11.43	surface	surfac e		LOWER TOWN	
870.	37227	Cuboid	Sub-classical	Damaged, Omitted	Sandstone	14.428	32.10	-	-	37x56x4	16	675	ER	IV/V
871.	9182	Cuboid	Sub-classical	Damaged, Omitted	Stone	29.191	30.01	29.01	13.40	55x24x1	2	8		
872.	23869	Cuboid	Sub-classical	Damaged, Omitted	Stone	33.890	49.67	40.73	22.78	surface	surfac e			
873.	1230	Cuboid	Sub-classical	Damaged, Omitted	Stone	191.244	55.53	50.30	37.28	45x94x3	pit 2 s.b 2	50		
874.	18087	Cuboid	Sub-classical	Modified	Steatite	3.650	14.99	11.66	9.85	57x99x1	2	70		
875.	8215	Cuboid	Sub-classical	Modified	Black stone	3.678	10.98	10.61	8.82	35x44x4	23	305-12		
876.	31087	Cuboid	Sub-classical	Modified	Sandstone	22.395	22.97	22.61	18.57	37 x 75 x 3	6	200	ER	IV
877.	3728	Amorphous	Sub-classical	Perfect	Basalt	5.616	15.09	13.48	13.33	C.19/4	2	10 - 20	CASTLE	
878.	31559	Barrel	Sub-classical	Perfect	Serpentine	0.452	6.17	8.02	-	55 x 3 x 1 + 2	pit s/b 1	55	MIDDLE TOWN	V
879.	32169	Barrel	Sub-classical	Perfect	Jasper	1.029	11.91	7.90	-	65 x33 x 3	5	145		
880.	32948	Barrel	Sub-classical	Perfect	Agate	1.166	12.47	7.80	-	65x33x1	1	15	MIDDLE TOWN	IV
881.	29492	Barrel	Sub-classical	Perfect	Agate	2.019	18.16	10.04	7.15	66x55x1	7	156	MIDDLE TOWN	IV
882.	54504	Conical	Sub-classical	Perfect	Shell	1.732	15.96	8.03	4.49	15x54x4	3	15		
883.	34817	Conical	Sub-classical	Perfect	Sandstone	2.286	17.65	8.97	6.66	45 x 13 x 1	3	36		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
884.	33486	Conical	Sub-classical	Perfect	Stone	3.151	20.12	9.27	8.31	48x38x1+2	16	730		
885.	52438	Conical	Sub-classical	Perfect	Sandstone	4.171	10.35	20.24	-	35 x 32 x 4	2	30 - 45	LOWER TOWN	
886.	30360	Conical	Sub-classical	Perfect	Limestone	58.088	31.56	36.50		37x75x3	2	130		IV
887.	18791	Cuboid	Sub-classical	Perfect	Shell	0.161	-	4.16	3.77	45 x 33 x 3	4	54	MIDDLE TOWN	V
888.	37134	Cuboid	Sub-classical	Perfect	Shell	0.564	8.91	8.55	3.93	45 x 73 x 4	3	63	MIDDLE TOWN	
889.	18459	Cuboid	Sub-classical	Perfect	Shell	1.193	9.59	9.16	5.53	58 x 53 x 4	surface			
890.	9979	Cuboid	Sub-classical	Perfect	Shell	1.196	8.37	8.33	7.32	46 x 39	3	52	LOWER TOWN	VI
891.	34021	Cuboid	Sub-classical	Perfect	Agate	1.311	11.03	7.46	7.33	45 x 13 x 3	3	53	MIDDLE TOWN	IV/V
892.	39151	Cuboid	Sub-classical	Perfect	Jasper	1.458	10.96	10.27	6.41	45x3x2	2	25-30		
893.	11408	Cuboid	Sub-classical	Perfect	Shell	1.918	13.49	9.91	6.34	47x15x2	6	142		
894.	49816	Cuboid	Sub-classical	Perfect	Hornblende	2.000	11.48	10.17	7.60	35x22x1	unstratified	48	LOWER TOWN	
895.	44790	Cuboid	Sub-classical	Perfect	Sandstone	2.099	10.85	9.81	9.62	45 x 68 x 4	2	31	MIDDLE TOWN	V
896.	22657	Cuboid	Sub-classical	Perfect	Gabbro	2.120	9.55	7.92	13.03	47 x 88 x 4	unstratified		CASTLE	
897.	18230	Cuboid	Sub-classical	Perfect	Agate	2.131	11.28	9.87	8.53	44x43x2	14	93		
898.	18130	Cuboid	Sub-classical	Perfect	Jasper	2.168	15.62	10.60	6.78	44x43x2/3	unstratified		MIDDLE TOWN	
899.	54281	Cuboid	Sub-classical	Perfect	Chert	2.199	11.24	9.25	8.03		9	175		
900.	54468	Cuboid	Sub-classical	Perfect	Stone	2.323	13.02	10.92	5.25	54x58x1	4	73	MIDDLE TOWN	IV
901.	46125	Cuboid	Sub-classical	Perfect	Chert	2.363	10.45	10.09	8.44	28 x 95 x 4	1	32	LOWER TOWN	V/VI
902.	44828	Cuboid	Sub-classical	Perfect	Agate	2.364	10.98	10.97	9.31	45 x 95 x 1	7	174	MIDDLE TOWN	IV

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
903.	3208	Cuboid	Sub-classical	Perfect	Basalt	2.390	10.78	10.40	6.92	A.18/1	7	160 - 70	CASTLE	V
904.	18011	Cuboid	Sub-classical	Perfect	Shell	2.476	14.42	11.54	6.17	56 x 53 x 2	3	129	MIDDLE TOWN	IV
905.	54497	Cuboid	Sub-classical	Perfect	Siltstone	2.530	11.63	10.90	8.14	55x24x2	1	5		
906.	9439	Cuboid	Sub-classical	Perfect	Shell	3.485	11.74	11.74	11.15	46 x 44	4	160	MIDDLE TOWN	V
907.	27593	Cuboid	Sub-classical	Perfect	Gabbro	3.525	11.94	11.67	11.03	67 x 52 x 1	5	90	BAILEY	V
908.	49092	Cuboid	Sub-classical	Perfect	Shell	3.568	14.80	13.18	8.42	47x74x1	5	145-47		
909.	44587	Cuboid	Sub-classical	Perfect	Terracotta	3.729	17.30	16.71	8.71	surface				
910.	25943	Cuboid	Sub-classical	Perfect	Basalt	3.790	14.37	11.25	11.99	25 X 5 X 2	13 b	141 - 56	LOWER TOWN	IV
911.	34269	Cuboid	Sub-classical	Perfect	Sandstone	4.333	14.46	14.33	9.89	47 x 85 x 4	1	15	CASTLE	
912.	11576	Cuboid	Sub-classical	Perfect	Sandstone	4.385	15.81	13.85	13.71	55 x 24	3	51	MIDDLE TOWN	
913.	7107	Cuboid	Sub-classical	Perfect	Sandstone	4.825	18.65	12.95	12.90	37x82x1	6	100 - 10		VI
914.	31650	Cuboid	Sub-classical	Perfect	Stone	5.361	16.08	15.85	15.22	65x33x4	2	55	MIDDLE TOWN	IV
915.	43190	Cuboid	Sub-classical	Perfect	Limestone	6.044	15.87	13.76	12.91	28 x 95 x 2	1	10	EMB.	V/VI
916.	15142	Cuboid	Sub-classical	Perfect	Shell	6.320	15.08	13.87	12.59	35 x 53 x 4	1	65	MIDDLE TOWN	V
917.	26016	Cuboid	Sub-classical	Perfect	Sandstone	6.773	21.35	15.22	13.69	25x5x2	18	191-94	LOWER TOWN	IV
918.	16404	Cuboid	Sub-classical	Perfect	Sandstone	6.839	19.21	11.74	12.35					
919.	30340	Cuboid	Sub-classical	Perfect	Stone	7.185	14.43	12.59	11.47	66x54x3	1	5	MIDDLE TOWN	VI
920.	11736	Cuboid	Sub-classical	Perfect	Limestone	15.013	22.92	21.17	13.04	45 x 44	pit s/b 1	28	MIDDLE TOWN	V
921.	34879	Cuboid	Sub-classical	Perfect	Sandstone	16.200	23.70	22.87	21.01	45x23x4	1	8	MIDDLE TOWN	

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
922.	25733	Cuboid	Sub-classical	Perfect	Stone	16.414	24.56	19.30	-	25x5x2	pit-1 s.b 5	115	LOWER TOWN	V
923.	19831 b	Cuboid	Sub-classical	Perfect	Sandstone	17.128	29.75	26.21	13.17	C.19/1	1 a/ surfac e ?	23	CASTLE	VI
924.	44336	Cuboid	Sub-classical	Perfect	Sandy limestone	17.150	29.99	23.14	15.93	55 x 87 x 2	4	96	MIDDLE TOWN	IV
925.	20132	Cuboid	Sub-classical	Perfect	Limestone	18.544	-	-	-					
926.	15221	Cuboid	Sub-classical	Perfect	Sandstone	20.355	26.90	25.22	20.31	55 x 58 x 1	4	125	MIDDLE TOWN	IV
927.	30898	Cuboid	Sub-classical	Perfect	sansstone	30.654	33.31	24.22	23.75	47x67x1x2	3	1-130		
928.	54462	Cuboid	Sub-classical	Perfect	Basalt	68.027	35.32	34.56	21.80					
929.	39128	Cuboid	Sub-classical	Perfect	Stone	117.603	40.48	32.57	56.24	surface				
930.	9924	Cylindroid	Sub-classical	Perfect	Shell	0.564	6.84	-	7.30	46x43	2	140		
931.	54552	Cylindroid	Sub-classical	Perfect	Shell	0.791	7.60	-	7.55	67x19x1+4	2c	160-210		
932.	54554	Cylindroid	Sub-classical	Perfect	Shell	0.819	8.06	-	7.71	24x4x3	2	10		
933.	54493	Cylindroid	Sub-classical	Perfect	Stone	2.650	8.56	7.80	-	58x18x4	2	102		
934.	1960	Cylindroid	Sub-classical	Perfect	Shell	2.860	12.41	-	9.81	ZA6	1	-		
935.	5005	Cylindroid	Sub-classical	Perfect	Shell	3.124	21.97	-	8.48	48x72xR 5	3	06-Dec		
936.	28500	Discoid	Sub-classical	Perfect	Grey Limestone	2.688	15.70	6.23	-	45x93x2	1	7	MIDDLE TOWN	V
937.	54495	Discoid	Sub-classical	Perfect	Chert	2.829	19.52	4.56	-	55x24x1	37	562		
938.	29147	Discoid	Sub-classical	Perfect	Stone	3.274	15.49	14.04	7.95	66x55x1	3	104	MIDDLE TOWN	IV
939.	22022	Prismatic	Sub-classical	Perfect	Stone	10.144	19.59	13.35	13.26	surface	surfac e	surface	LOWER TOWN	
940.	48354	Spheroid	Sub-	Perfect	Shell	1.537	10.02	-	8.22	35x73x324	1	68		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
			classical											
941.	15282	Spheroid	Sub-classical	Perfect	Agate	2.245	13.25	8.12	-	35x53	2	70		
942.	19337	Spheroid	Sub-classical	Perfect	Shell	3.003	11.92	11.58	11.87	54x58x3	3	25		
943.	8159	Spheroid	Sub-classical	Perfect	Sandstone	3.519	16.17	13.66	8.36	57x16x2	2	100		
944.	54467	Spheroid	Sub-classical	Perfect	Sandstone	3.948	17.51	17.19	9.99	55x84x4	2	51-60	MIDDLE TOWN	
945.	6755	Spheroid	Sub-classical	Perfect	Chalcedony	5.865	18.81	16.47	11.63	47x48x4	(23) N	420 - 35	CASTLE	IV
946.	8865	Spheroid	Sub-classical	Perfect	Stone	137.718	51.69	33.90	-	47x78x4	2	90	CASTLE	V
947.	39323	Tabloid	Sub-classical	Perfect	Shell	0.520	9.71	8.70	2.63	47x73x2	2	15	CASTLE	VI
948.	18808	Tabloid	Sub-classical	Perfect	Sandstone	39.591	38.26	33.95	18.81	54x58x1		10		
949.	34368	Discoid	Sub-classical	Perfect, damaged	Terracotta	20.884	42.88	10.10	-	35x93x4	1	26-37		
950.	38685	Discoid	Sub-classical	Partly Chipped	Terracotta	4.440	21.64	7.86	-	45x3x3	22	468	MIDDLE TOWN	
951.	54465	Discoid	Sub-classical	Partly Chipped	Limestone	130.000	60.75	20.30		47x35x3	1	10	CASTLE	V
952.	44606	Conical	Sub-classical	Slightly Chipped	Jasper	2.446	8.88	16.88	-	55x87x3	1	19	MIDDLE TOWN	IV
953.	19495	Cuboid	Sub-classical	Slightly Chipped	Terracotta	2.105	11.76	11.74	11.82	57 x 60 x 2	3	130	BAILEY	V
954.	6646	Cuboid	Sub-classical	Slightly Chipped	Terracotta	5.410	15.78	15.21	14.05	57x5x3	2	35 - 40	CASTLE	VI
955.	32922	Cuboid	Sub-classical	Slightly Chipped	Stone	8.282	23.36	17.56	13.32	55x53	1	17	MIDDLE TOWN	
956.	37619	Cuboid	Sub-classical	Slightly Chipped	Sandstone	8.548	21.49	15.98	-	35x63x1	1	93	MIDDLE TOWN	IV
957.	22191	Cuboid	Sub-classical	Slightly Chipped	Sandy limestone	17.752	25.32	24.89	20.82	37x24x4	2	54		
958.	53905	Cuboid	Sub-classical	Slightly Chipped	Sandstone	21.070	26.60	26.32	18.64	47x74x4	18	370	CASTLE	IV

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
959.	30496	Cuboid	Sub-classical	Slightly Chipped	Stone	36.869	38.49	24.43	22.57	37x55x2+3	11	398		
960.	4545	Cuboid	Sub-classical	Slightly Chipped	sansstone	41.601	32.07	23.35	17.30	A13/4	7	510		
961.	577	Cuboid	Sub-classical	Slightly Chipped	Sandstone	90.261	45.40	43.46	26.69	A.14/4	surface		CASTLE	VI
962.	40248	Cuboid	Sub-classical	Slightly Chipped	Gabbro	270.828	66.95	49.22	32.85	55 x 75 x 1	1	7	MIDDLE TOWN	V
963.	2932	Cylindroid	Sub-classical	Slightly Chipped	Chert	33.718	32.96	21.06	20.13	xn-19	1	18	BAILEY	V
964.	21312	Cylindroid	Sub-classical	Slightly Chipped	Stone	49.710	37.13	19.87	-	35x33x2	3	70	LOWER TOWN	V
965.	54511	Discoid	Sub-classical	Slightly Chipped	Terracotta	0.976	11.92	6.56	-	35x94x2	2a	-55		
966.	29885	Discoid	Sub-classical	Slightly Chipped	Chert	1.436	9.28	8.13	-	45 x 83 x 3	1	15	MIDDLE TOWN	V
967.	54551	Discoid	Sub-classical	Slightly Chipped	Shell	1.461	11.07	-	6.89	55x82x3	2	8		
968.	35167	Discoid	Sub-classical	Slightly Chipped	Terracotta	1.721	14.20	7.63	-	46x62x4	1	-156		
969.	46333	Discoid	Sub-classical	Slightly Chipped	Terracotta	2.314	16.99	5.98	-	25x83x2	4	68	LOWER TOWN	
970.	34414	Discoid	Sub-classical	Slightly Chipped	Pottery	5.772	27.61	25.20	7.34	45x13x1	2	22	MIDDLE TOWN	
971.	19127	Discoid	Sub-classical	Slightly Chipped	Stone	6.680	20.38	19.60	12.05	58x53x1	1a	75	CASTLE	VI
972.	39174	Discoid	Sub-classical	Slightly Chipped	Agate	7.387	20.20	11.00	-	surface				
973.	54489	Discoid	Sub-classical	Slightly Chipped	Sandstone	7.394	15.43	14.54	9.99	58x55x2	1	281	B/L	MIX
974.	50095	Discoid	Sub-classical	Slightly Chipped	Limestone	9.608	23.17	21.85	10.33	47x84 R-8	6	171	CASTLE	
975.	33914	Discoid	Sub-classical	Slightly Chipped	Sandstone	41.374	45.23	42.64	18.30	45x13x2	3	32		
976.	54409	Discoid	Sub-classical	Slightly Chipped	Sandstone	550.000	9.00	3.70	-	s.r suface				
977.	15293	Pebble	Sub-classical	Slightly Chipped	Jasper	42.115	33.8	30.33	28.45	48x42x4	1	24		

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
978.	52905	Spheroid	Sub-classical	Slightly Chipped	Shell	0.854	9.48	5.88	-	47x73x3	29	60	CASTLE	
979.	18658	Spheroid	Sub-classical	Slightly Chipped	Shell	1.768	11.51	10.68	8.33	57x54x3	2	555		
980.	518	Spheroid	Sub-classical	Slightly Chipped	Terracotta	2.900	15.13	-	10.45	35 x 83 x 1 + 2	5	163	MIDDLE TOWN	IV
981.	43405	Spheroid	Sub-classical	Slightly Chipped	Sandstone	3.202	15.37	12.17	-	67x54x1	3	200		
982.	54300	Spheroid	Sub-classical	Slightly Chipped	Sandstone	18.852	29.14	28.05	20.71	surface	surface		Eastern reserviour	
983.	7298	Spheroid	Sub-classical	Slightly Chipped	Sandstone	29.660	29.38	28.06	25.35	55 x 85 x baulk	3	27	MIDDLE TOWN	IV
984.	16087	Spheroid	Sub-classical	Slightly Chipped	Limestone	32.479	28.92	26.33	23.96	5x94x3	pit-2 s/b 6	129		
985.	36448	Spheroid	Sub-classical	Slightly Chipped	Sandstone	34.839	34.03	29.02	-	45x3x3	5	128	MIDDLE TOWN	
986.	18432	Spheroid	Sub-classical	Slightly Chipped	Sandstone	49.280	35.55	24.03	-	57x57x3	2	85	BAILEY	IV
987.	54432	Spheroid	Sub-classical	Slightly Chipped	Stone	65.000	40.00	33.04	-	47x35x3	1	5	CASTLE	V
988.	9125	Spheroid	Sub-classical	Slightly Chipped	Sandstone	10300.000	21.50	15.00		zb.7/4	2	20		
989.	13677	Cuboid	Sub-classical	Unfinished	Agate	1.955	11.47	10.77	8.09	15x44x3	2	114		
990.	32193	Cuboid	Sub-classical	Unfinished	Chert	2.888	15.88	10.67	10.02	66x56x2	2	53		
991.	24075	Conical	Sub-classical, remodified		Basalt	3.324	10.12	8.20	21.44	37 x 34 x 3	5	2-2.5		
992.	54413	Cuboid		Damaged, Omitted	Limestone	510.000	83.01	75.43	39.53	55x78x4	7	166	MIDDLE TOWN	IV
993.	54531	Hemispheroi		Damaged, Omitted	Sandstone	460.000	83.13	78.20	51.47	47x74x3	3	55	CASTLE	
994.	54506	Cuboid		Unfinished	Agate	3.953	18.78	13.72	8.43	47x36x1	3	140		
995.	54550	Conical			Limestone	35700.000	16.2-19.9	49.5	-	58x21x2				

Sl. No.	Acc. No.	Shape	State	Condition	Object	Weight	D1	D2	D3	Locus	Layer	Depth	Locality	Peri
996.	22020	Cylindroid			Sandstone	270.000	59.08	49.15	-	55x60x1	5	185 - 00	MIDDLE TOWN	IV

8.4 Beads

Beads occupy an important position in antiquity record. In the Indian sub-continent, beads of lapis lazuli, turquoise, steatite, shell, carnelian, jasper and limestone are noticed as early as the Neolithic levels of Mehrgarh (8^{th} – 6^{th} millennium BCE) (Jarrige et al 1995). Since then, beads become one of the most favoured items for personal decoration. It seems that during the Harappan times, it rose to become a full flagged industry. A variety of materials looked for and collected from near or far-off regions.

A huge quantity as quality of beads produced for the domestic markets to which even raw materials were sent. The Indus acquired such a reputation for lapidary work that their products caught the fancy of the people of outside countries among which Mesopotamia and Elam were, perhaps, the biggest buyers. So much valued were their beads that those were worn by the persons Buried in the royal tombs at Ur or were sent to Mari, perhaps, as offering to divinities. If but natural that bead-making had become as cottage industry as its evidence has been found at several sites of any size.

Dholavira was no exception to the rule. In fact, Dholavira has emerged as one of the greatest centres for making stone beads as is abundantly clear from the find of lumps of raw materials, debitage, wasters, blanks as well as huge quantity drill bits and grooved stone used for grinding beads. It must be stated that Dholavira enjoy the unique distinctions of yielding as many as 1270 drill bits, by far the largest from any Indus sites. These have been found in many a type and size.

Dholavira has added advantage as some of the raw materials like agate, carnelian, carnelian, chalcedony, and jasper are available in Kachchh. There is a large mine for these in the island Medhok or Mardek Beyt (named after the British Resident Mac Murdow, who did their and whose tomb stand on the opposite shore of the Rann at village Baranu Dala) in Little Rann. Besides, the chalcedonic stone are available at Fatehgarh near Surkotada and many sites are littered up with the pebblets of this stone at several places in Kachchh including Khadir, although those are not commercially/ industrially viable. Yet there is every chance that there are many localities in the land which might have been exploited by the

Harappans. So far the material of drill-bits remains unprovenanced and petrologically unidentified. Since these bits were first noticed and described by Earnest Mackay at Chanhudaro (Mackay:), this has been jujunely christened as ‘earnestite’. Dholavira has yielded, besides the bits, its raw material in pieces or in a pebble form. Possibility is strong that it may be located somewhere in Kachchh.

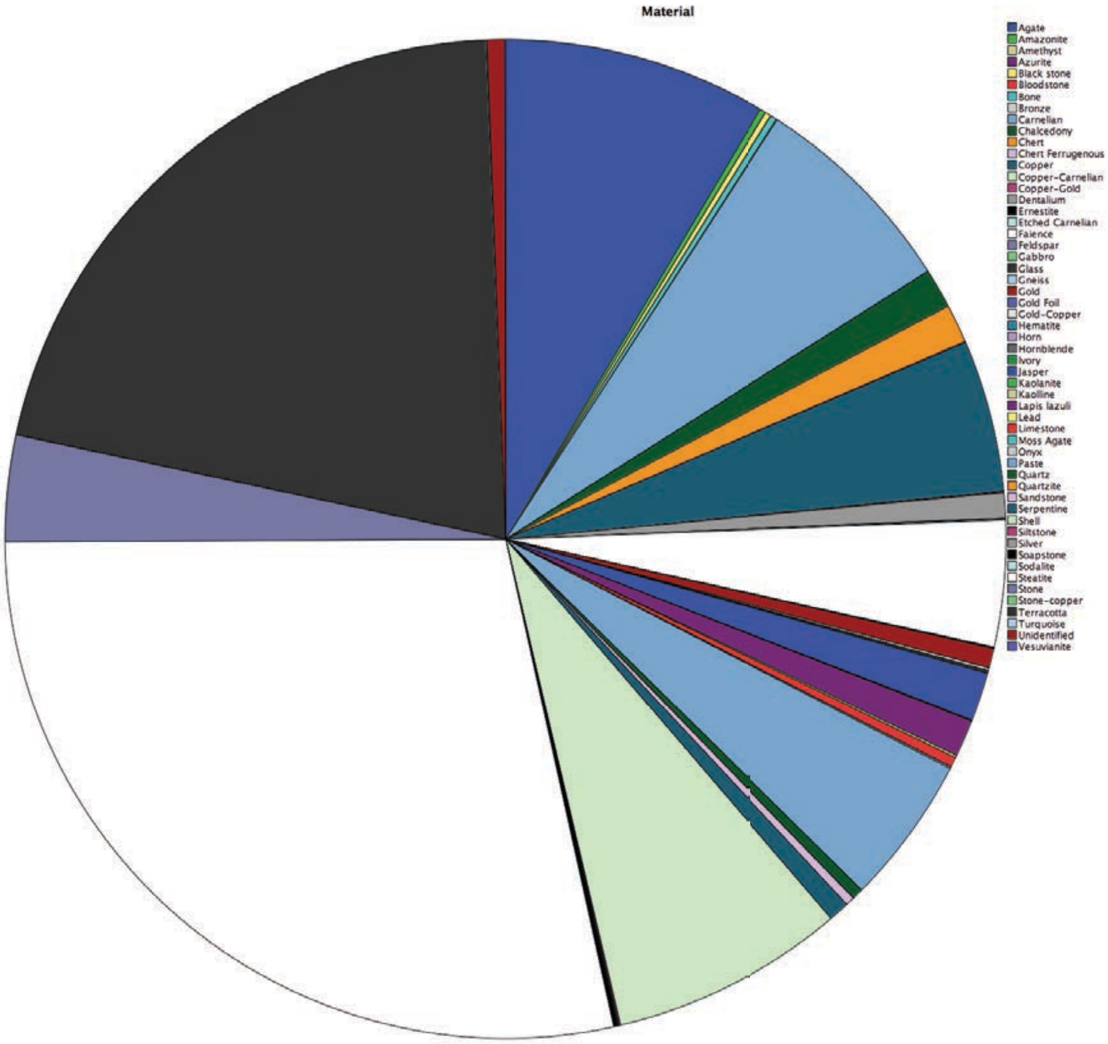


Fig. 8.77: Pie chart showing the distribution of materials of beads

The number of beads accessioned is 10776 of all categories of raw materials including the stone beads. However, it has been observed that as per the accession register several items have been listed with number of beads in each of the accession number. If we take into account of all the additional beads in many of the single accession number, the total number of beads comes to 12307 beads. A percentage-wise representation of raw materials of all the beads

indicate that steatite dominate the preference in terms of raw materials with a total number of 3493 beads (28.4%) followed by terracotta (2585, 21%), agate (1046, 8.5%), shell (934, 7.6%), carnelian (844, 6.9%), copper (6.9%), paste (591, 4.8%), unassorted stones (423, 3.4%), jasper (193, 1.6%), chalcedony and chert (158 & 154, 1.3% each) and lapis lazuli (147, 1.2%).

The other raw materials varieties are represented by less than 1%. Among them the prominent ones are dentalium (100, 0.8%) serpentine (82, 0.7%), gold (78, 0.6%). The pie-chart representing the individual raw material varieties is given above. However, it may be added here that the identification of raw materials and the analysis therein in purely based on the entries made in the accession register and the final identification of raw material varieties may add new categories of materials.

8.4.1 Locality-wise analysis of beads of all categories

The beads were also analysed based on the locality of finds. The analysis for determining the locality was available for 12087 beads). The analysis indicates that that maximum number of beads was found from Middle Town (5032, 41.6%) followed by Castle (3747, 31%), Lower Town (1754, 14.5%), Bailey (629, 5.2%). If we take into the habitational remains into account, clearly Middle Town dominates the scenario and this is also equally true when compared to the number of drill bits found from this area.

The analysis indicates a clear preference of Middle Town for craft specialisation activities. This is followed by minor percentages of finds mostly from a secondary context from other places. The Southern Reservoir area has the most number of beads among the secondary deposit contexts, which brough to light 257 beads (2.1%), followed by Eastern Reservoir (225, 1.9%), Multipurpose Ground (136, 1.1%), East Gate Ramp Area (109, 0.9%), Small Stadium (105, 0.9%), Cemetery (35, 0.3%). The distribution of beads of all categories based on the raw material is shown in the pie-chart below.

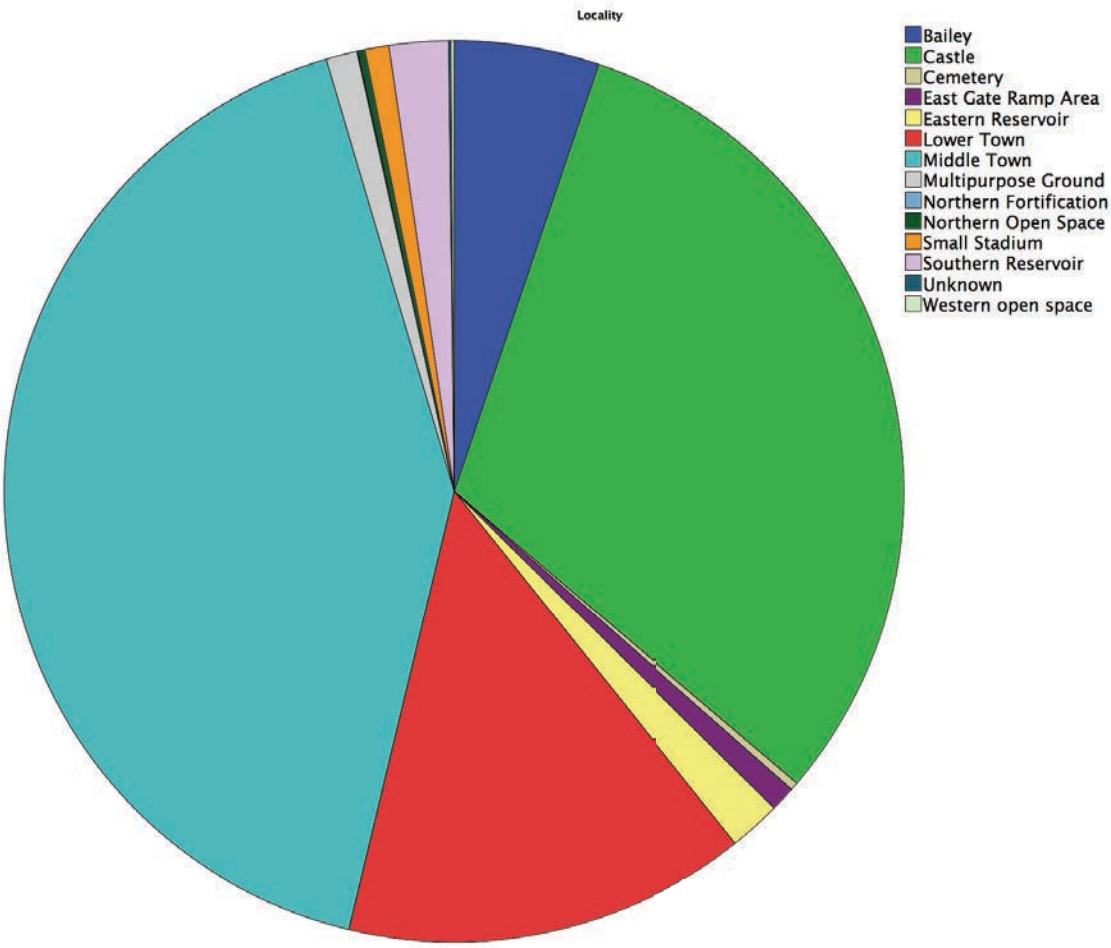


Fig. 8.78: Chart showing the locality wise analysis of beads of all categories

8.4.2 Analysis of stone beads

A total of 7744 stone beads were identified from the overal bead collection. These stone beads were also analysed to understand the dominant raw material variety. The analysis again indicate that steatite was the most preferred material for making beads. A total of 3457 beads (44.6%) are of steatite followed by raw materials like agate (1018, 13.1%), carnelian (829, 10.7%), paste (586, 7.6%), (faience (501, 6.5%), unidenfied stone (410, 5.3%), jasper (190, 2.5%), chalcedony (156, 2%), chert (150, 1.9%), lapis lazuli (146, 1.9%), and the remaining varieties are less than 100 in number and thus respresent a vary minor collection. The pie-chart for the raw material wise analysis of stone beads is given below for better understanding the preference of materials.

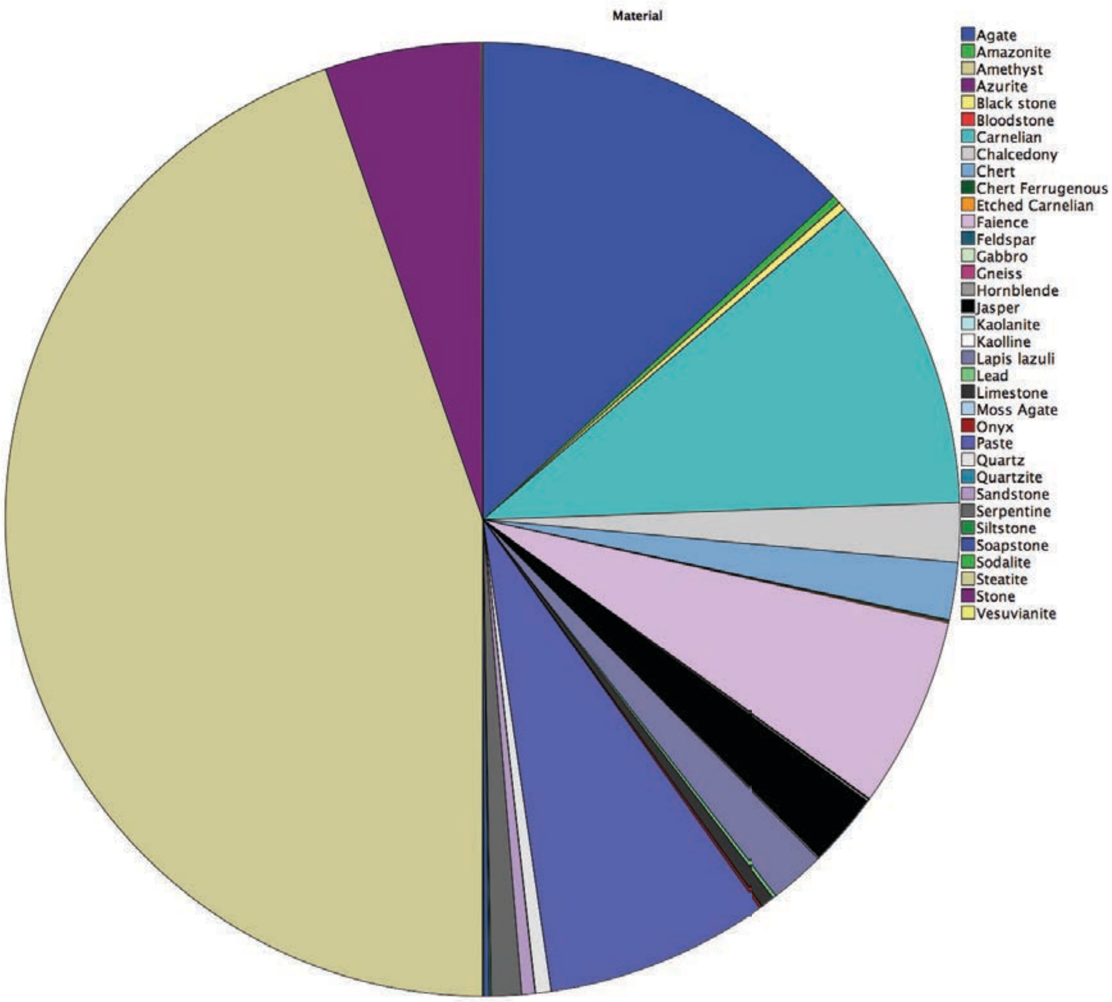


Fig. 8.79: Chart showing the raw material wise analysis of beads of all categories

8.4.2.1 Locality-wise analysis of stone beads

A total of 7744 stone beads were available for locality-wise analysis. The locality-wise analysis of stone beads indicate the domination of again Middle Town which is represented by 3326 beads (42.9%) followed by Castle (2609, 33.7%), Lower Town (866, 11.2%), Bailey (363, 4.7%). This is followed by other non-habitation areas like Eastern Reservoir (160, 2.1%), Southern Reservoir (141, 1.8%), Multipurpose Ground (86, 1.1%), Small Stadium (69, 0.9%), East Gate Ramp Area (62, 0.8%). The pattern of findings more or less coincides with the pattern for the overall beads of all raw materials. The same pattern is observed for the main habitation areas, with only a slight deviation for Bailey, wherein the beads of all raw materials is slightly over 5%. A pie-chart showing the location-wise analysis of stone beads is shown below.

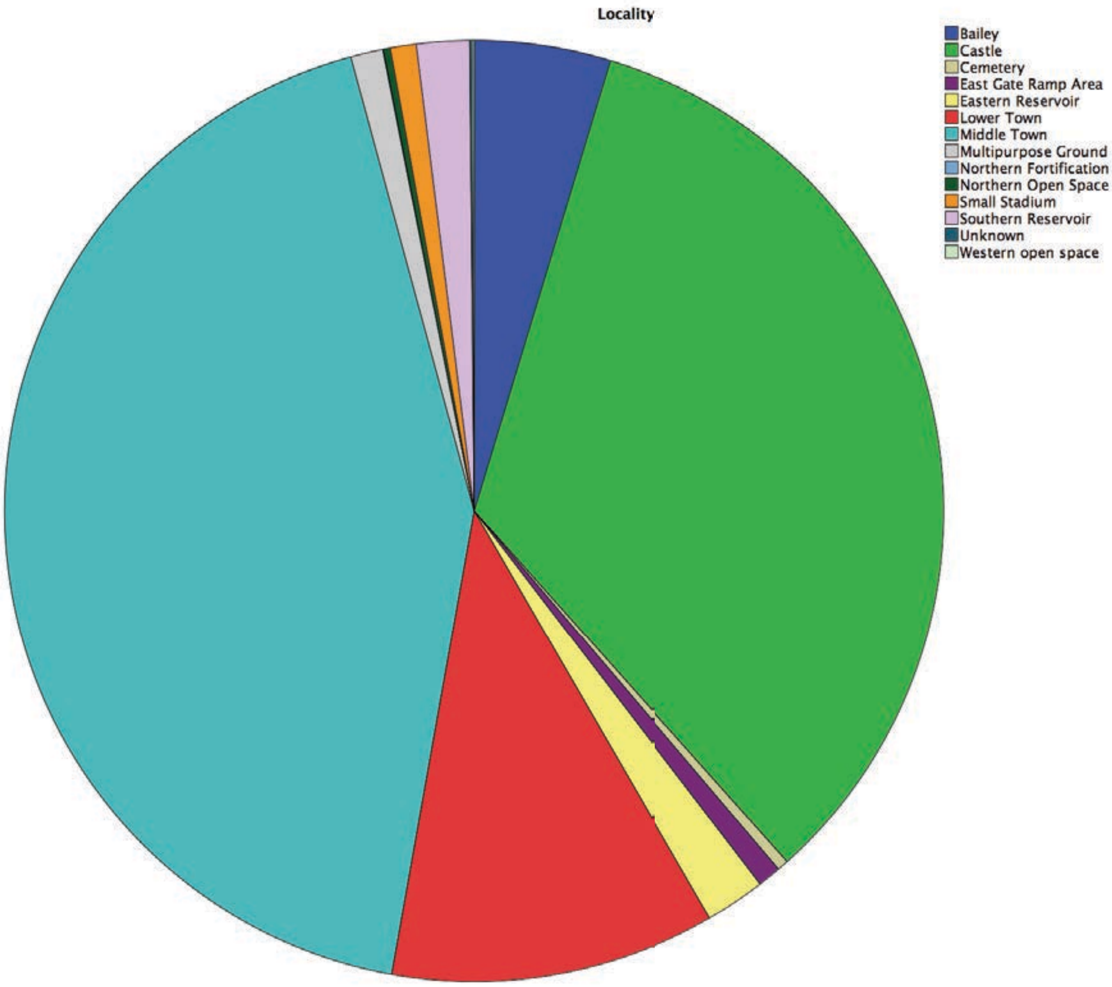


Fig. 8.80: Chart showing the locality wise analysis of stone beads only

8.4.2.2 Raw material for the beads and other materials

Analysis of the raw materials for the stone beads and other artefacts have been done for select artefacts by Randall Law and the detailed report is presented at the end of this chapter. However, as per the analysis carried out above, the raw materials that are present in large numbers include those of steatite and terracotta. Among the stone beads, a broad analysis indicate the presence of agate-carnelian, various colours and shades of jasper, chalcedony, amethyst, lapis lazuli, basalt, onyx, amazonite, bloodstone, turquoise, mudstone, etc. A representative collection of beads from various stone raw materials is given below:

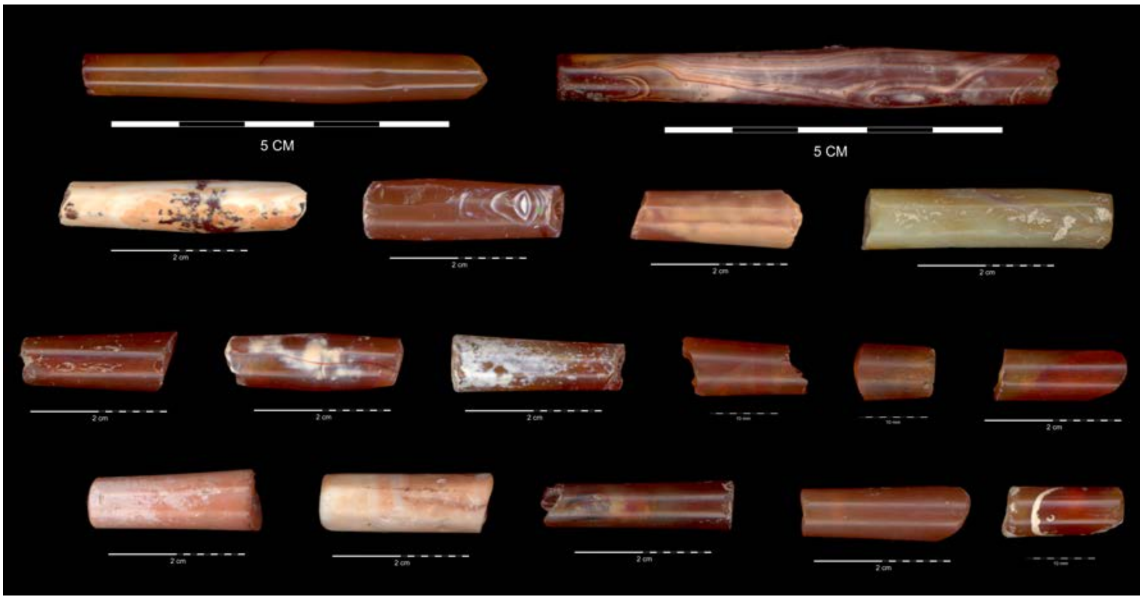


Fig. 8.81: Long barrel cylindrical beads of agate-carnelian

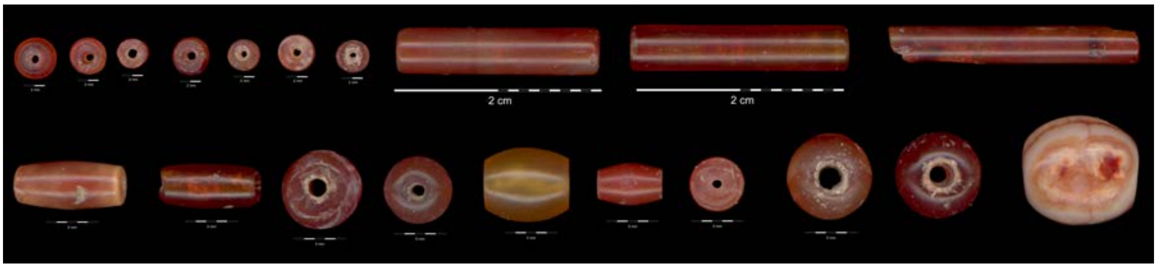


Fig. 8.82: Long barrel cylindrical and small bicone beads of agate-carnelian

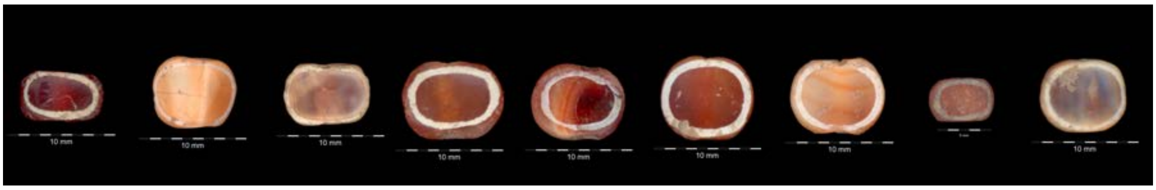


Fig. 8.83: Etched carnelian beads

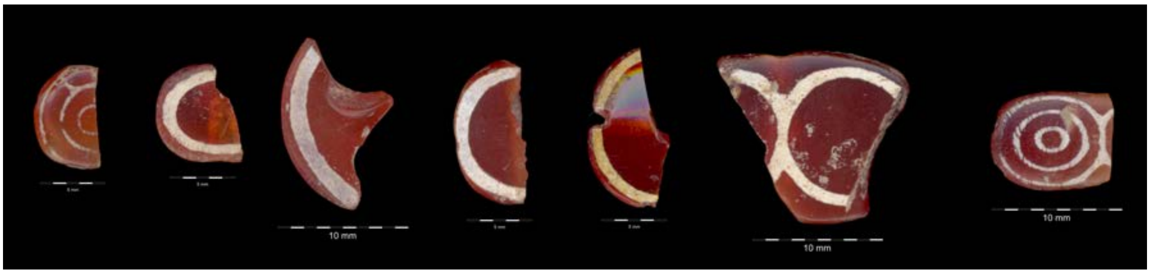


Fig. 8.84: Etched carnelian beads

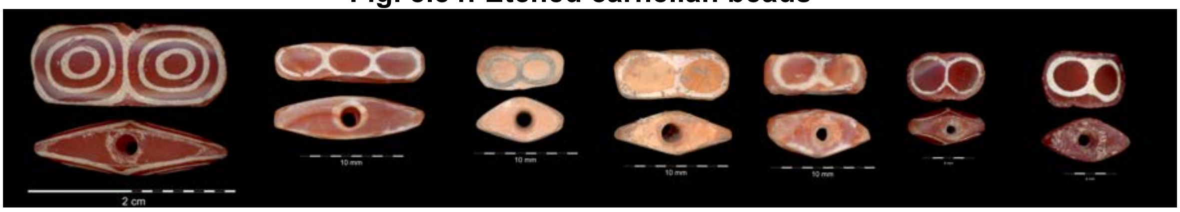




Fig. 8: Etched carnelian beads

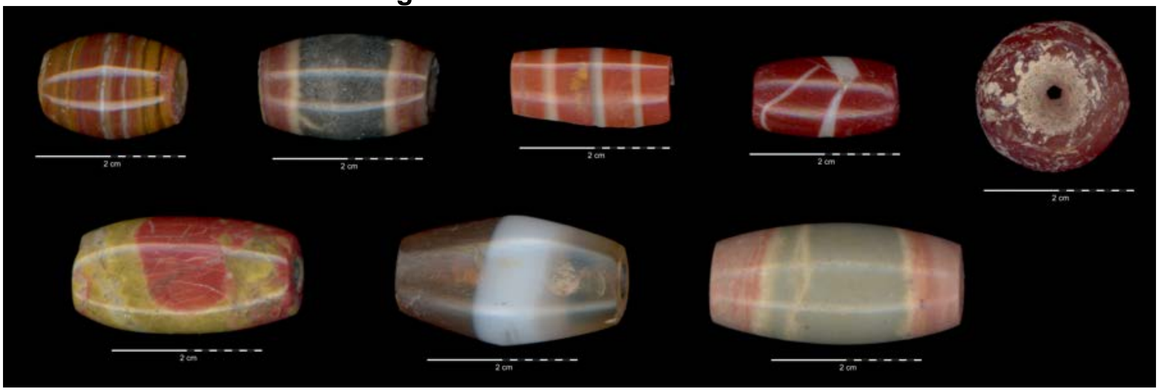


Fig. 8.85: Various shades of jasper beads



Fig. 8.86: Jasper and agate beads



Fig. 8.87: Roughouts of agate-carnelian beads

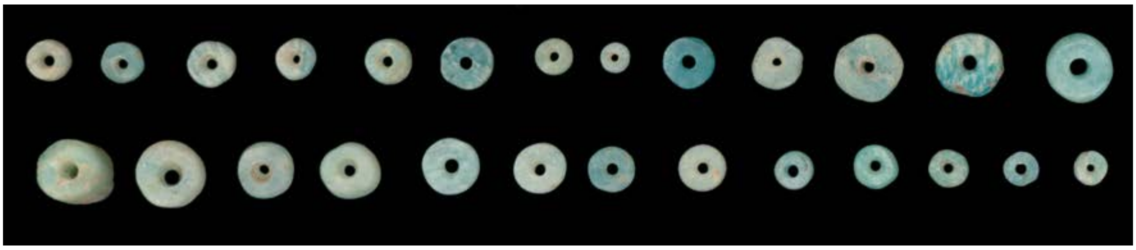


Fig. 8.88: Amazonite beads



Fig. 8.89: Amazonite beads

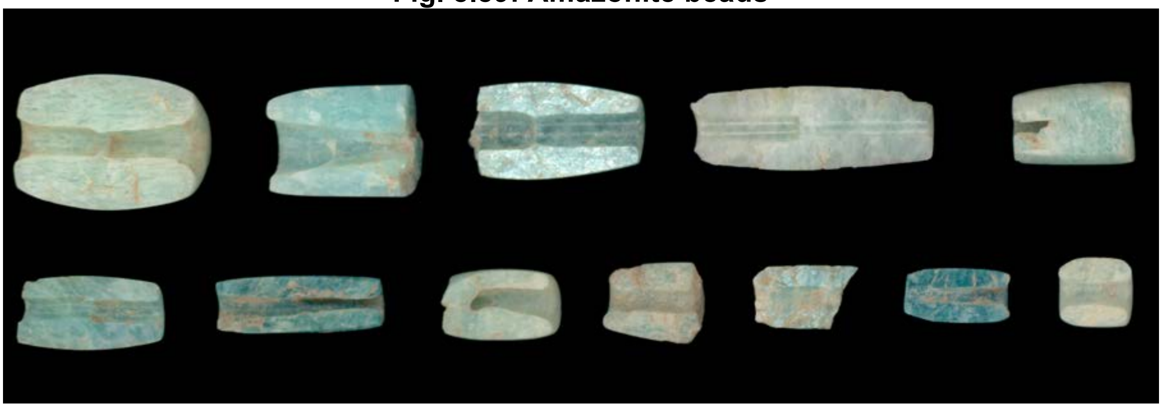


Fig. 8.90: Amazonite beads; half broken ones, showing drill patterns



Fig. 8.91: Blackstone beads; Basalt?



Fig. 8.92: Amazonite, moss agate and vesuvianite beads

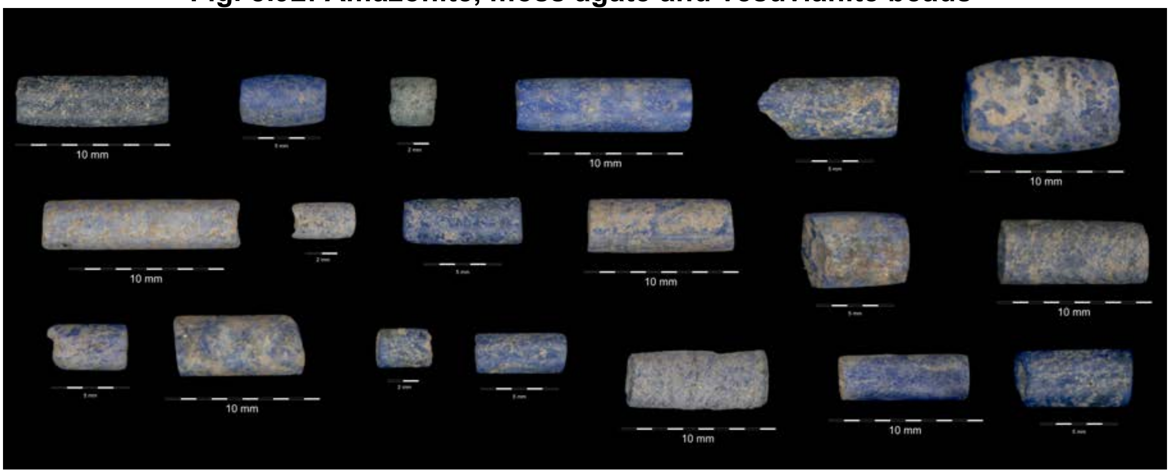


Fig. 8.93: Lapis lazuli beads

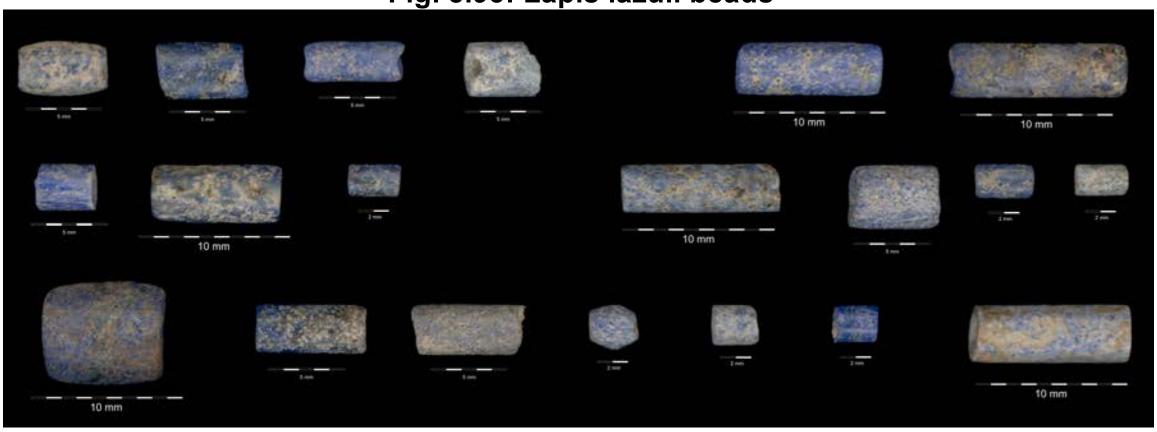


Fig. 8.94: Lapis lazuli beads

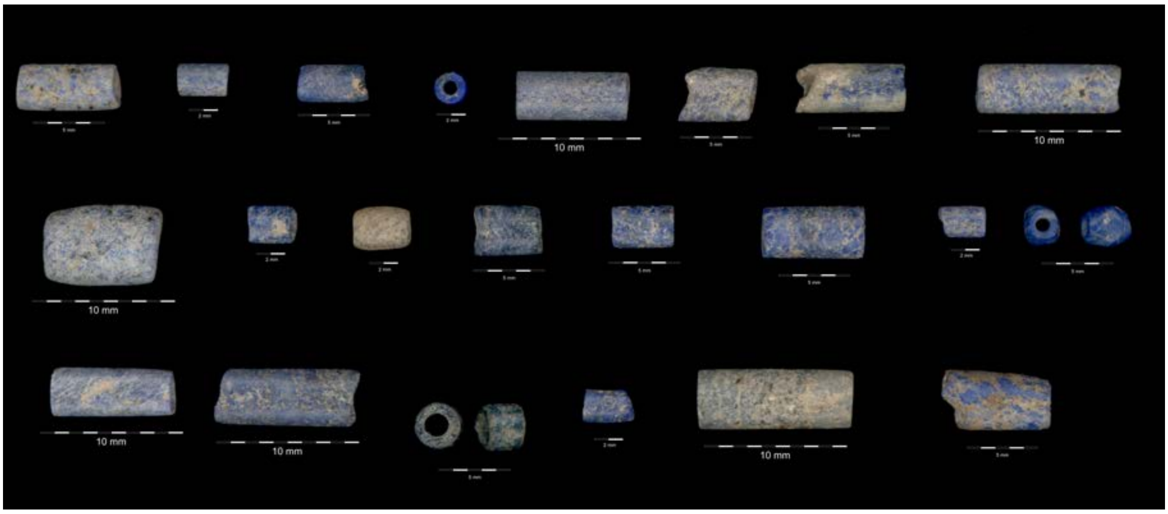


Fig. 8.95: Lapis lazuli beads

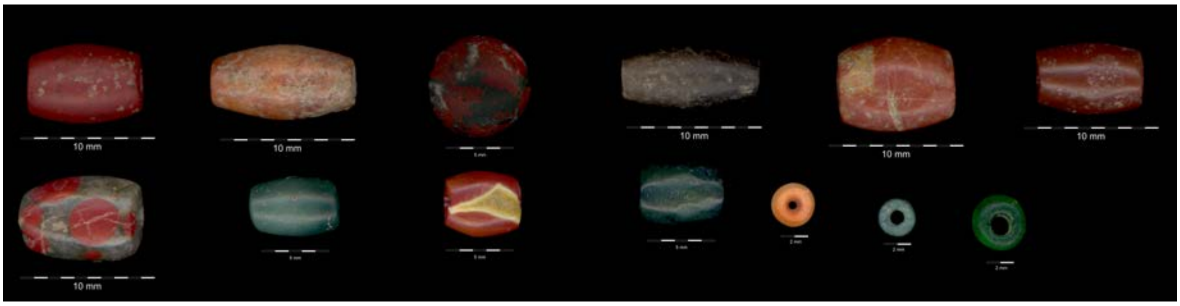


Fig. 8.96: Beads of jasper, bloodstone



Fig. 8.97: Beads of agate-carnelian, vesuvianite



Fig. 8.98: Beads of agate, jaspers, limestone, etc

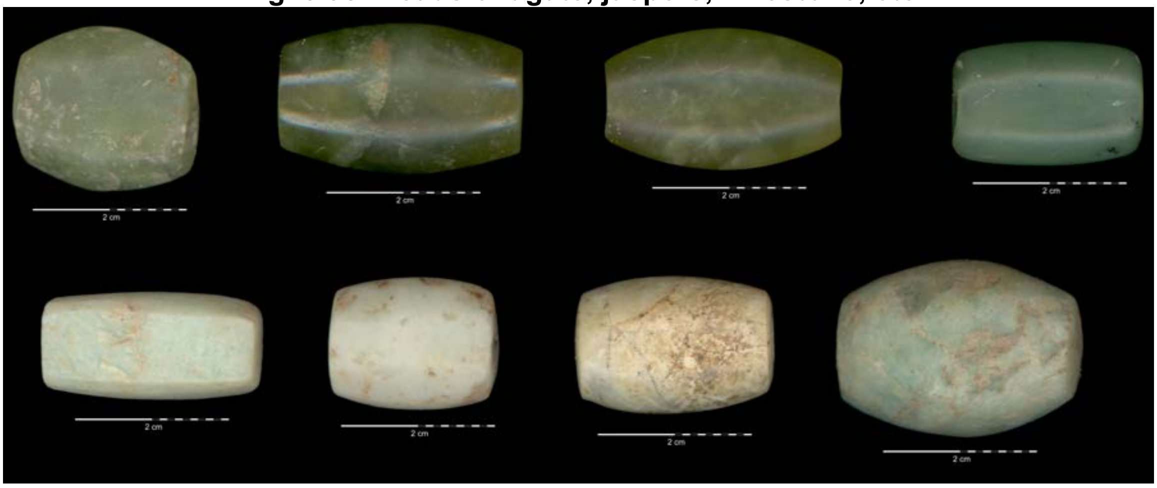


Fig. 8.99: Beads of vesuvianite



Fig. 8.100: Beads of agate-carnelian

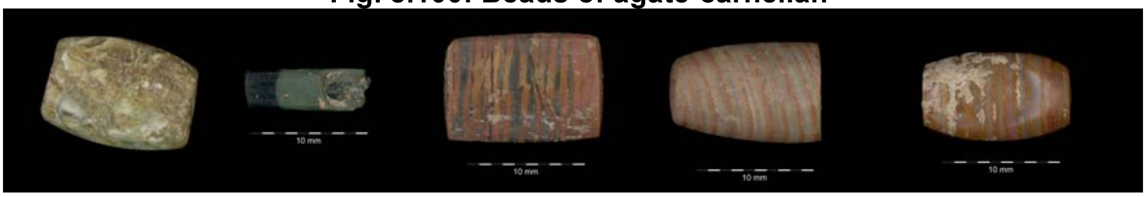


Fig. 8.101: Beads of agate-carnelian



Fig. 8.102: Beads of fossiliferous limestone

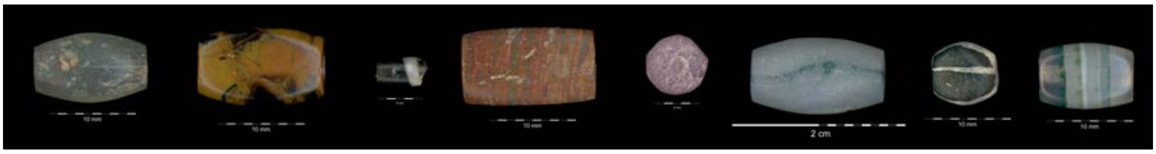


Fig. 8.103: Beads of agate-carnelian

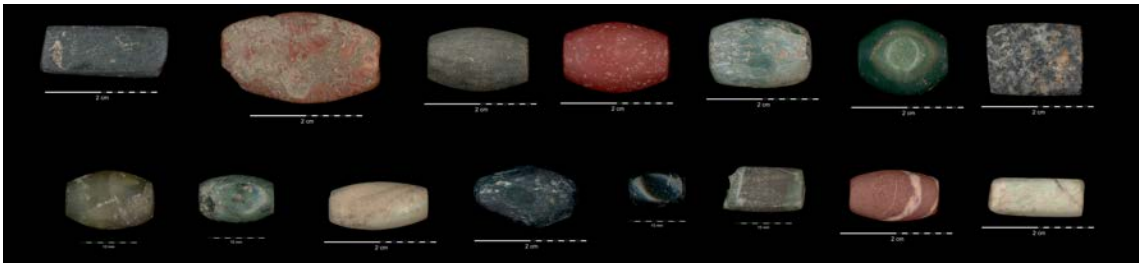


Fig. 8.104: Beads of agate-carnelian and jaspers



Fig. 8.105: Beads of steatite

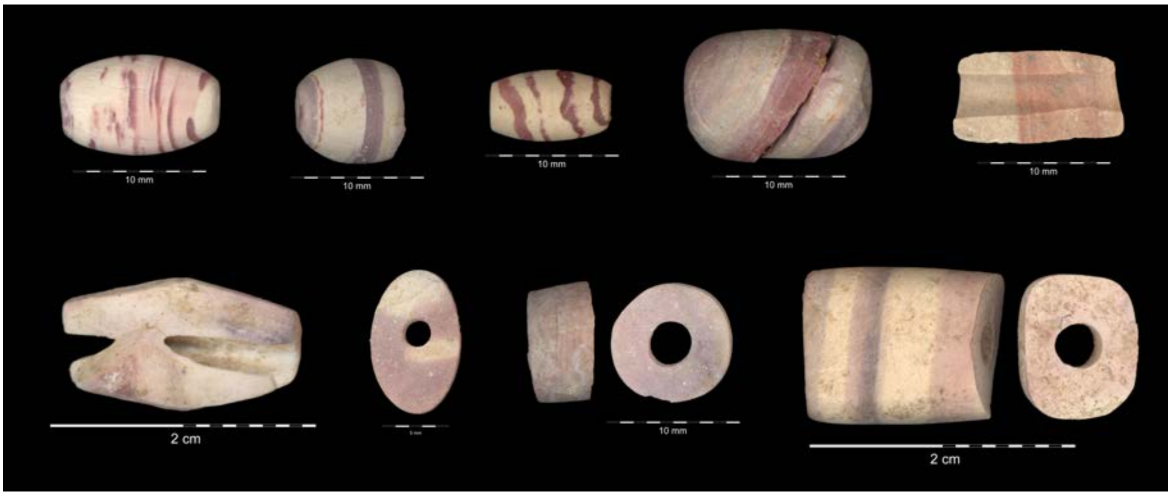


Fig. 8.106: Beads of mudstone / siltstone

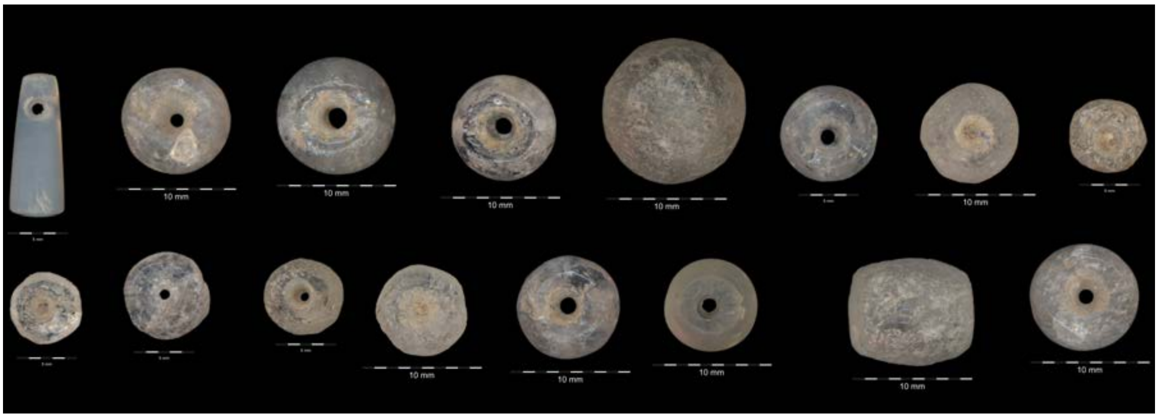


Fig. 8.107: Beads of quartz

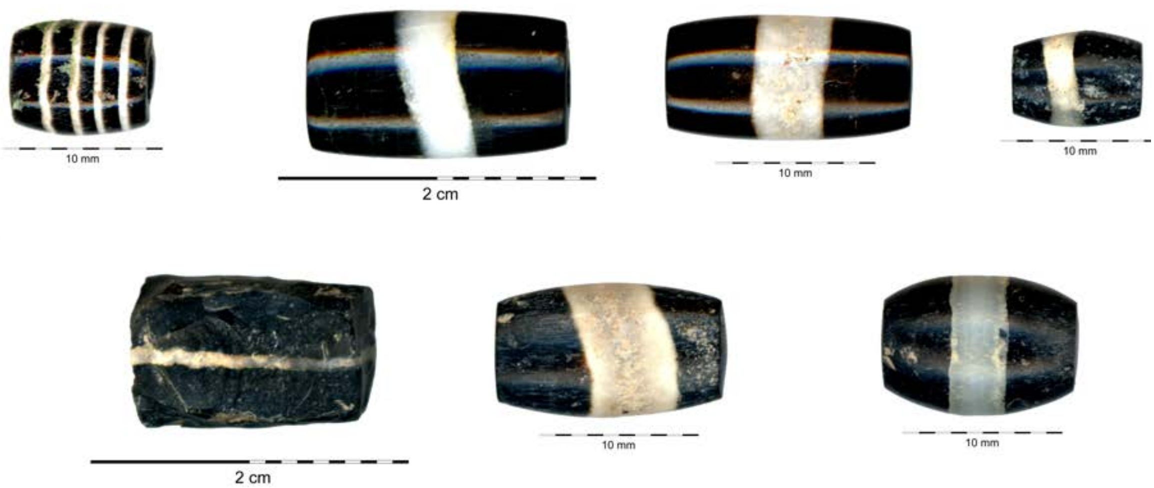


Fig. 8.108: Beads of agate

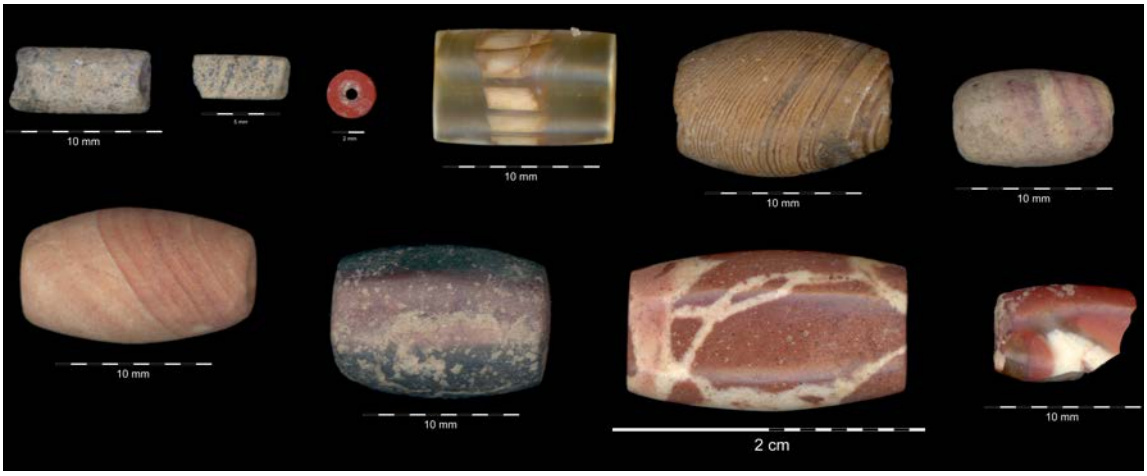


Fig. 8.109: Beads of agate-carnelian and jaspers

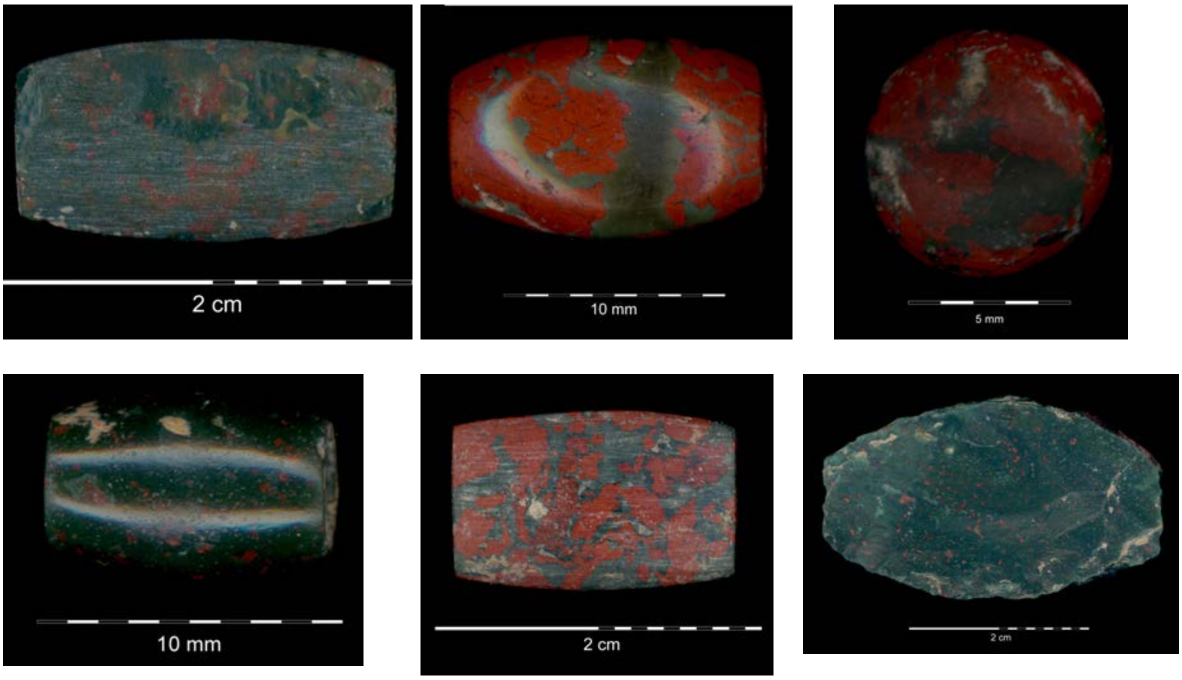


Fig. 8.110: Beads of bloodstone



Fig. 8.111: Faceted long bead of bloodstone

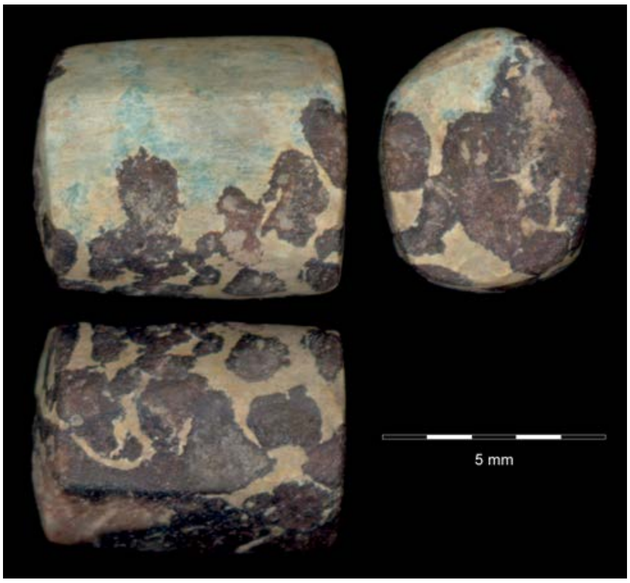


Fig. 8.112: Turquoise

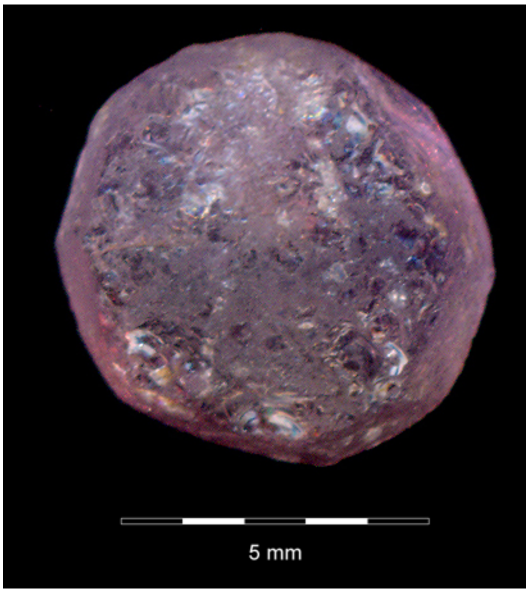


Fig. 8.113: Amethyst



Fig. 8.114: A cache of unperforated beads

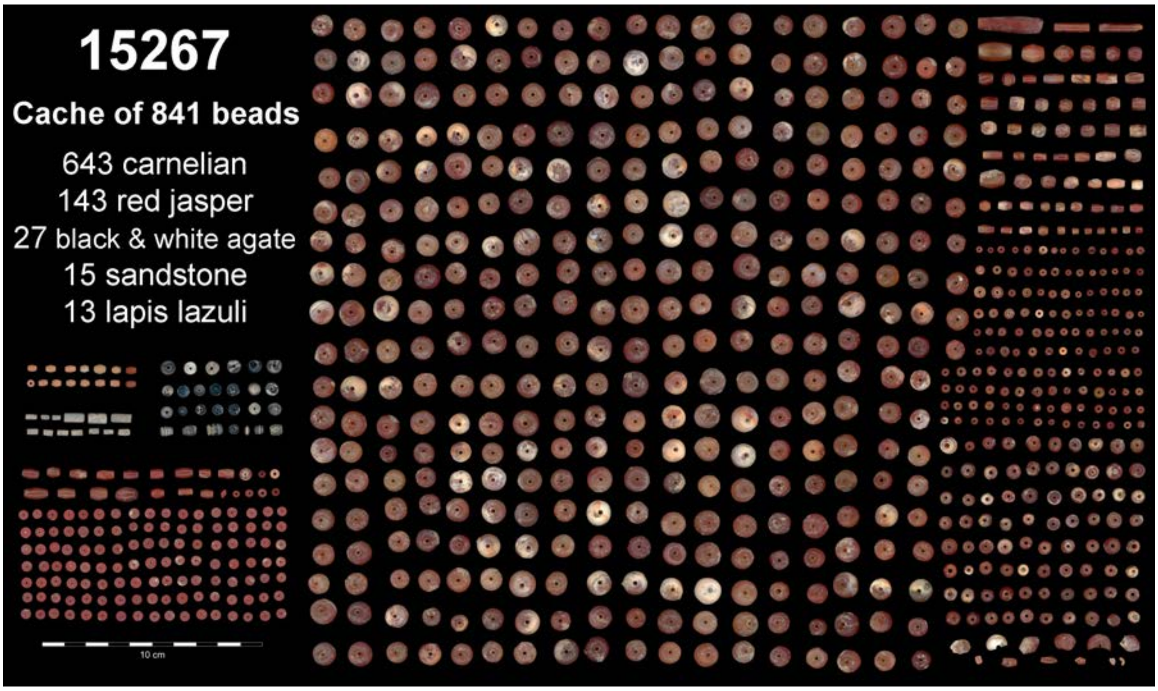


Fig. 8.115: A cache of beads of various raw materials





Fig. 8.116: Beads of unfired steatite



Fig. 8.117: Beads of steatite

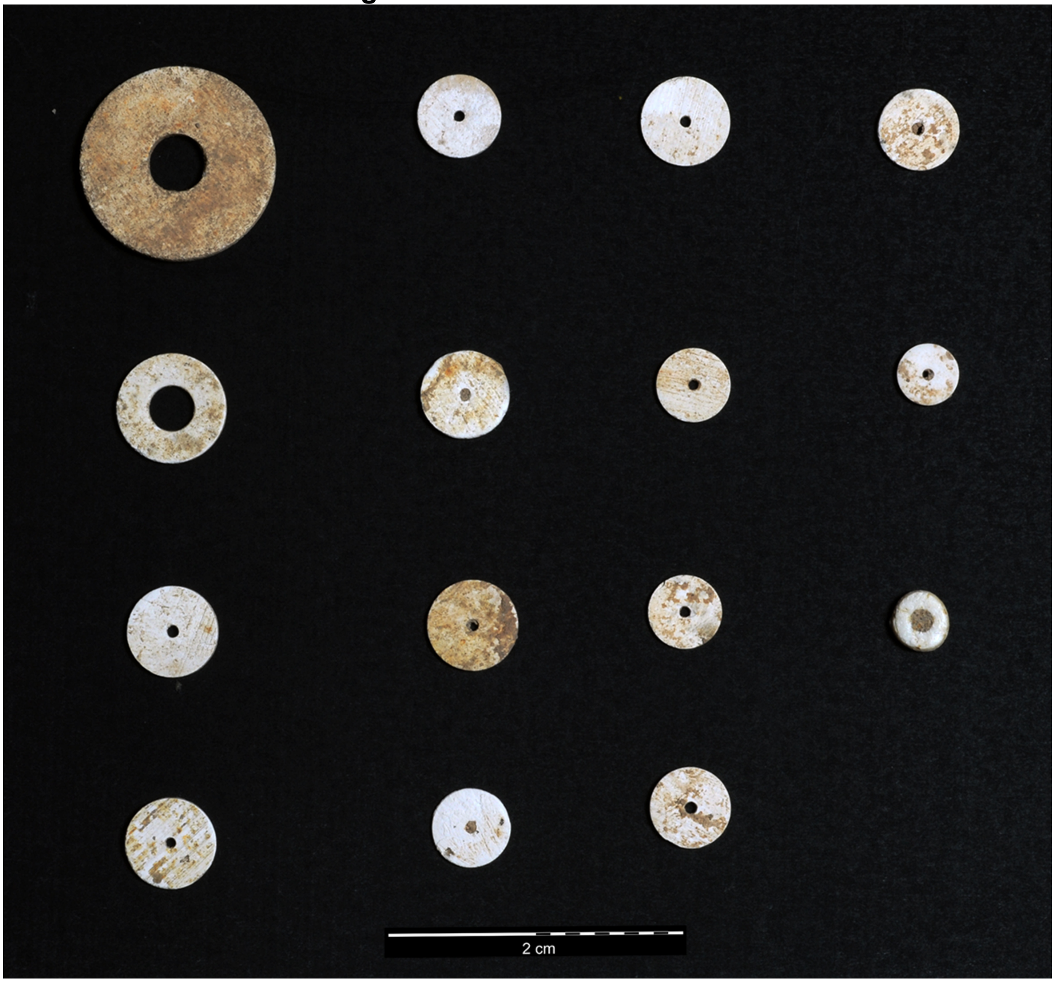


Fig. 8.118: Beads of steatite

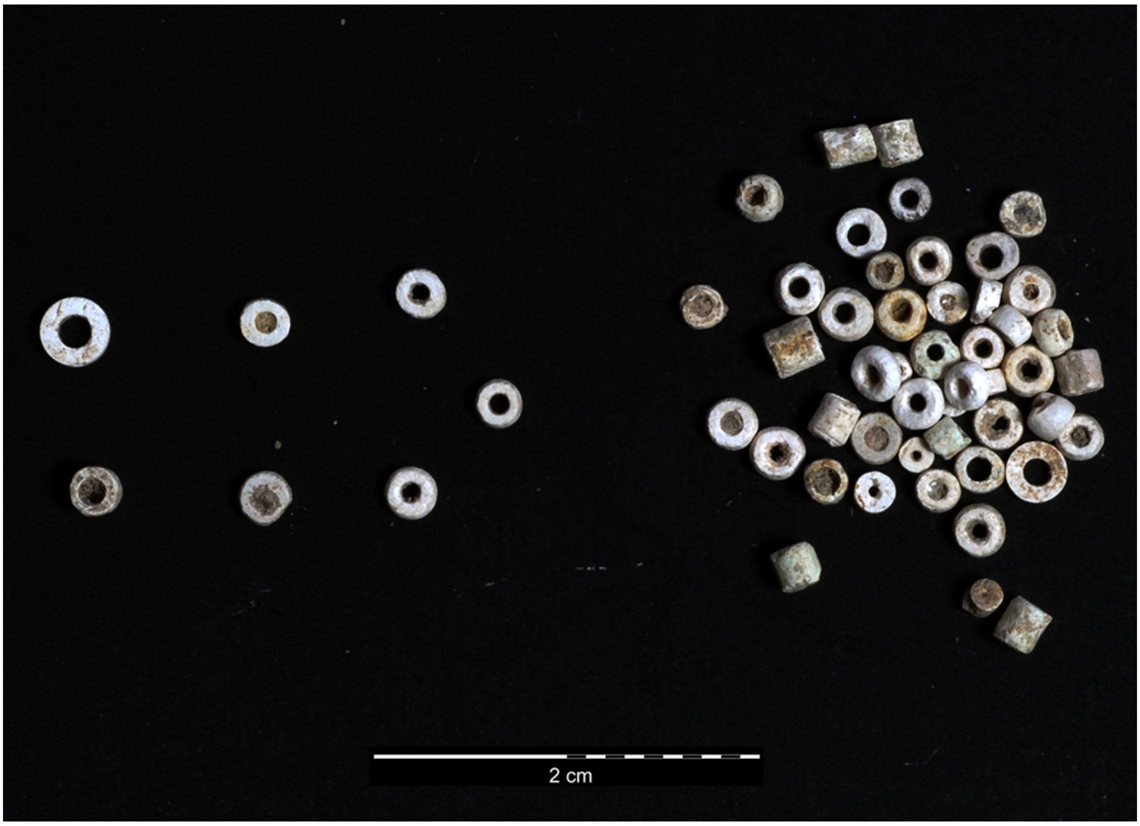


Fig. 8.119: Micro beads of steatite

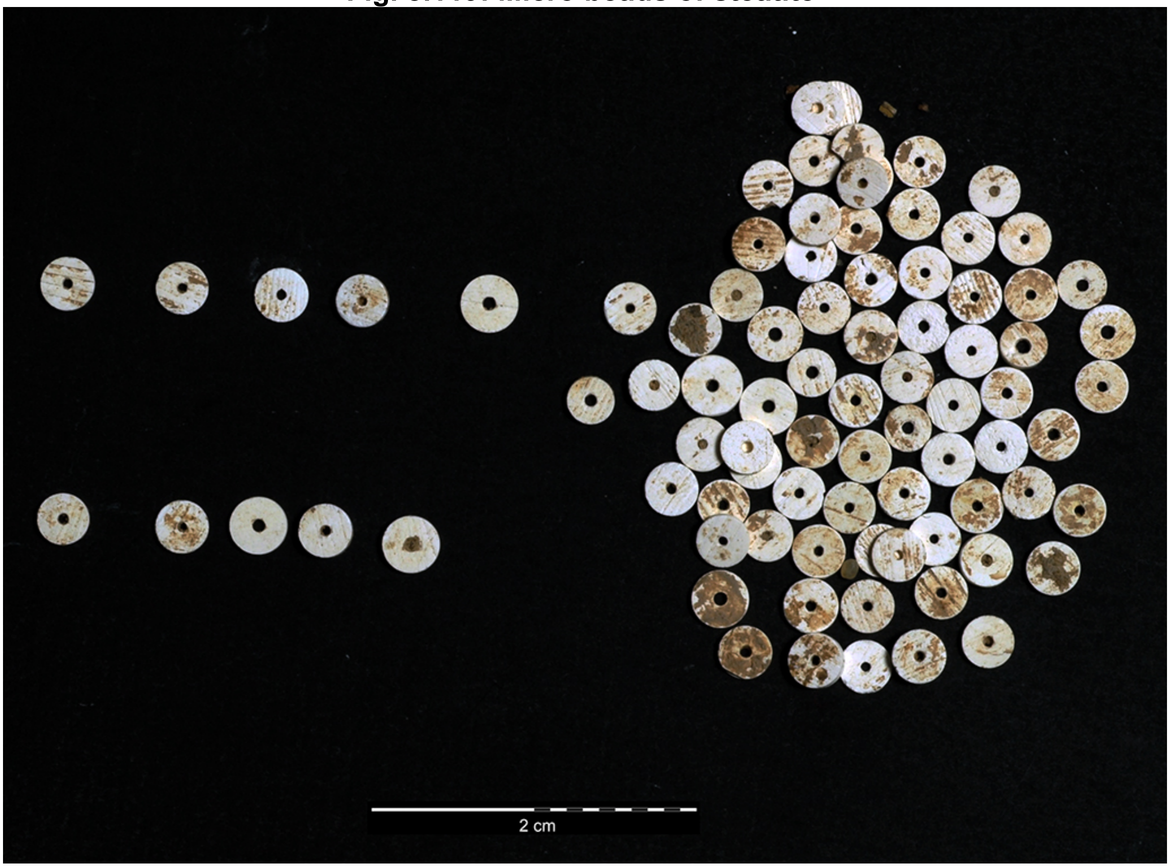


Fig. 8.120: Disc beads of steatite

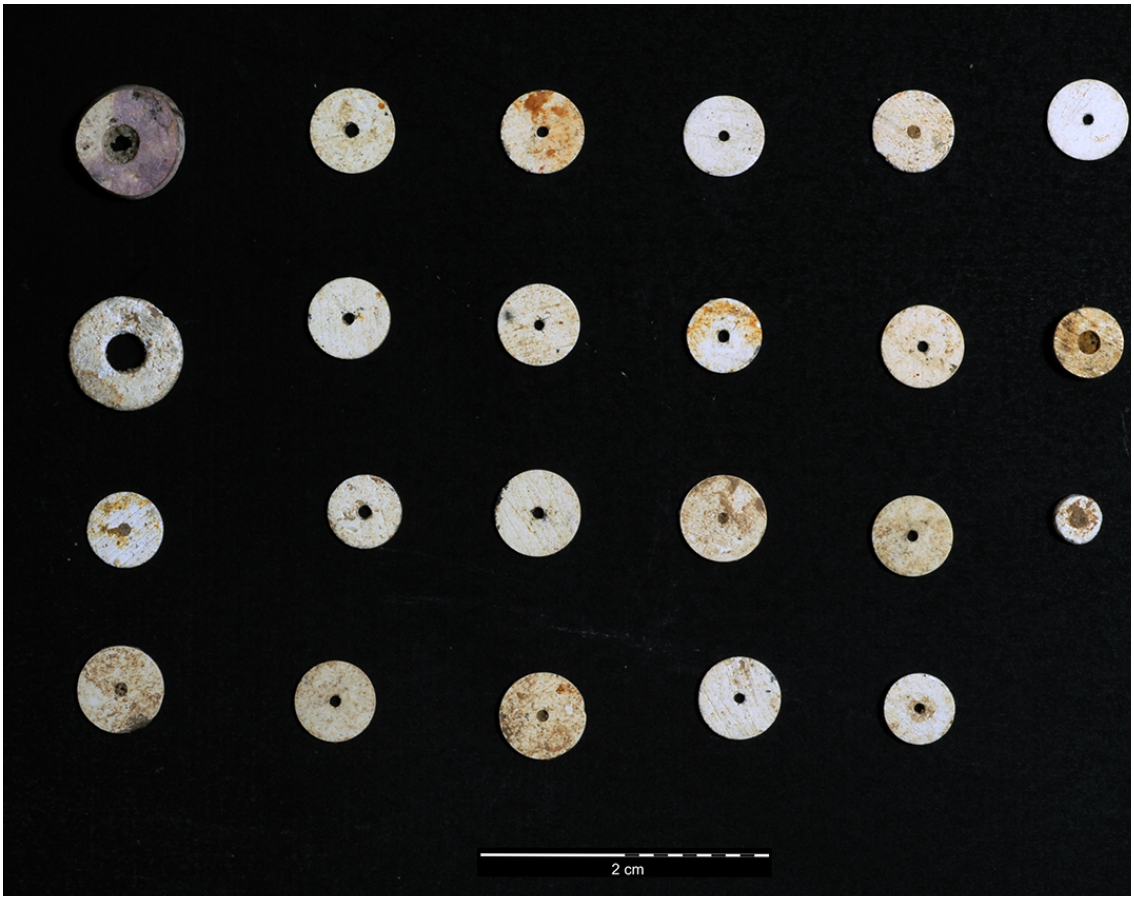


Fig. 8.121: Disc beads of steatite

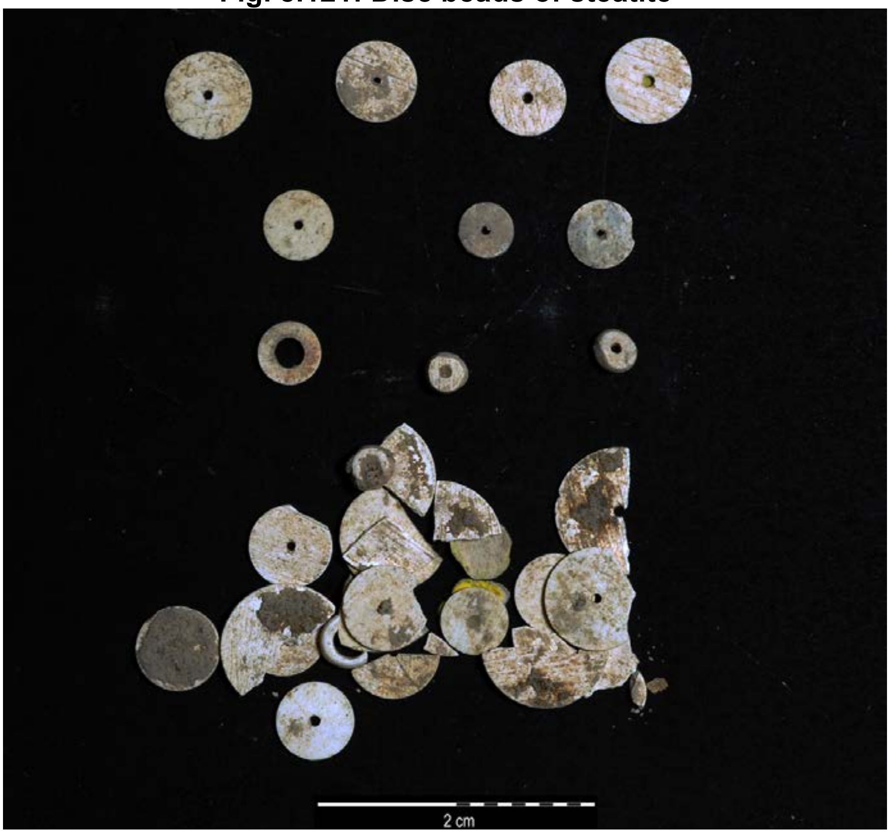


Fig. 8.122: Disc beads of steatite

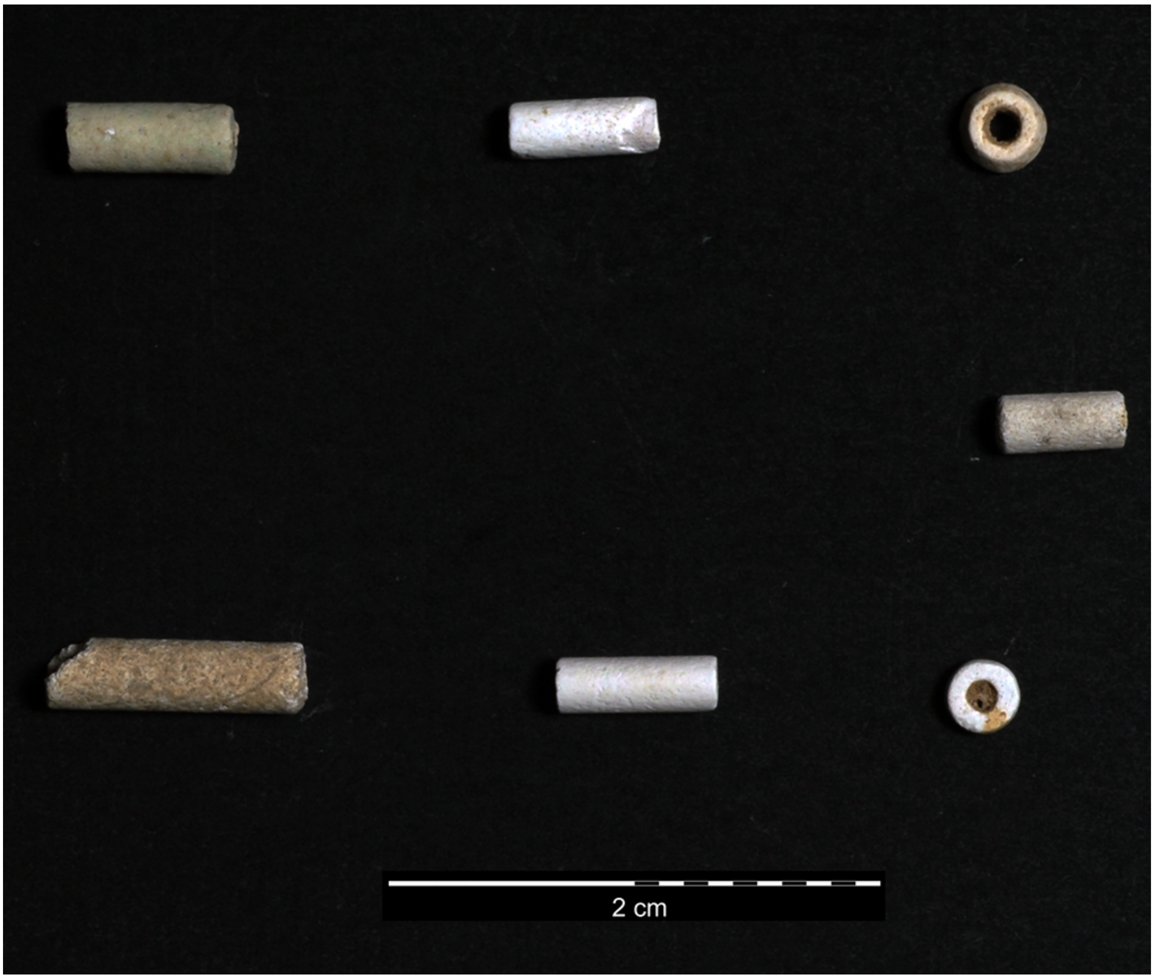


Fig. 8.123: Beads of steatite



Fig. 8.124: Beads of terracotta



Fig. 8.125: Beads of terracotta



Fig. 8.126: Beads of various shapes and spacer beads of terracotta



Fig. 8.127: Long tubular bicone beads of terracotta

8.4.3 Gold Beads

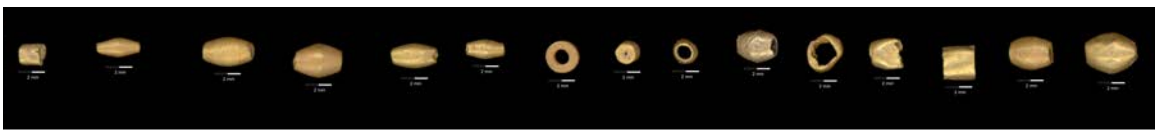




Fig. 8.128: Beads of gold, gold-copper

8.4.4 Silver Beads

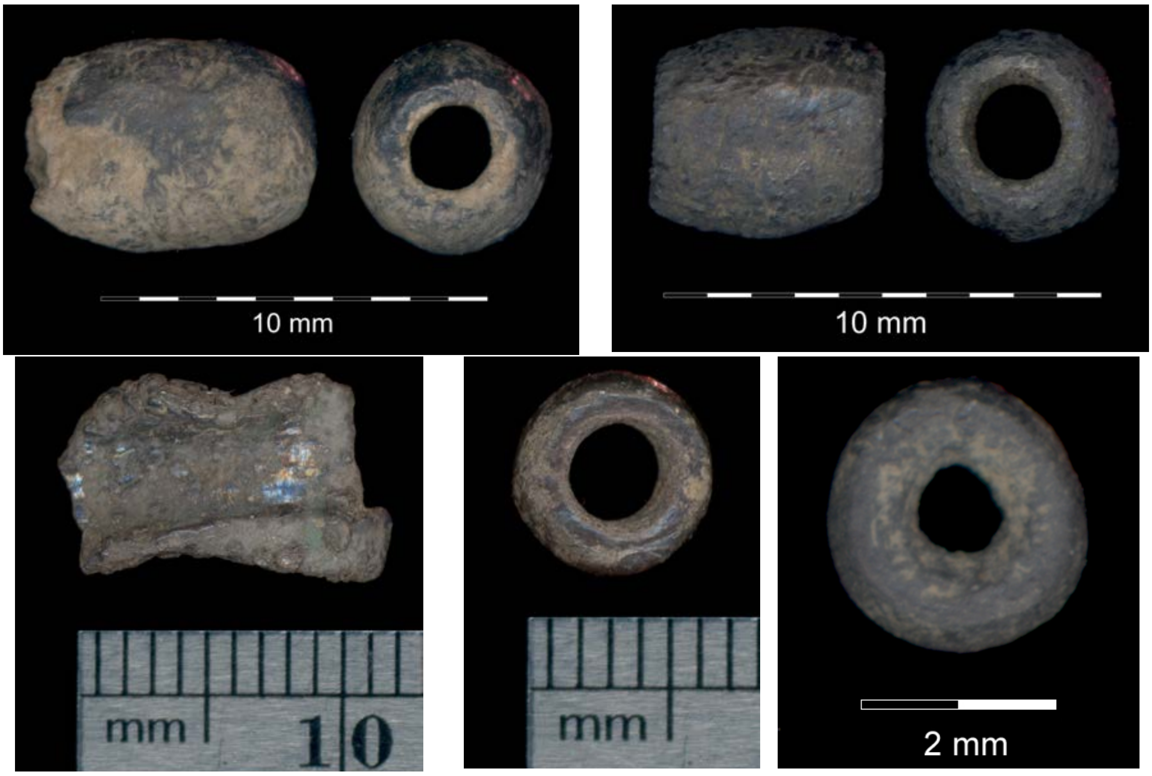


Fig. 8.129: Beads of silver

8.4.5 Bead Polishers



Fig. 8.130: Bead polishers



Fig. 8.131: Bead polisher



Fig. 8.132: Bead polisher

Evidence for bead polishers has also been brought to light from the excavations at Dholavira. The bead polishers were usually on the sandstones and limestones available locally. The deep grooves on the surface of these bead polishers clearly indicate the intense rubbing activities at the site. The presence of *in situ* bead polishers inside the rooms of house complexes also indicate the nature of bead manufacturing activities at the site. One such evidence comes from Stage VI house complex to the west of North Gate of Bailey, wherein two bead polishers are still found inside the rooms. The bead polishers were extensively used and often grooves are found on all the sides, indicating that once one face or surface is exhausted, the stone is turned over and other available surfaces were used for rubbing and polished the bead roughouts.



Fig. 8.133: Bead polishers



Fig. 8.134: Bead polisher *in situ* from Bailey, Dholavira

Another interesting evidence of a bead manufacturing workshop comes from near the West Gate of Castle. The presence of reused pillar elements that belonged to Harappan phase of Dholavira in a Stage VI house indicates the deurbanisation phase at this site and no longer these pillar elements were in use. The evidence indicates the arrangement of these pillar elements, at least three of them, arranged in a row and provisions for sitting arrangement of the craftsmen

towards the south. These stone pillar elements could have been used as anvil for chipping the stone bead roughouts.



Fig. 8.135: A bead making workshop near West Gate, Castle, Dholavira

8.4.5.1 Polisher for drill bits

Another evidence for the extensive bead manufacturing activities at the site of Dholavira is the presence of large number of ernestite drill bits. A detailed analysis of all the drill bits available from the site is presented separately. However, the polisher for ernestite drill bits is also present and the fine grooves on this stone clearly matches one of the drill bits.



Fig. 8.136: Polisher / Shaping Tool for drill bits



Fig. 8.137: Polisher / Shaping Tool for drill bits

8.4.6 Analysis of drill bits from Dholavira

8.4.6.1 History of research on drill and drilling technology of beads

The bead manufacturing and drilling mechanism was first studied by E.J.H. Mackay on the Mohenjo-daro and Chanhu-daro material (1937: 1-15). Of particular interest among the beads was a variety described by Mackay as "long barrel-cylinder shape" which were made of agate and carnelian. These beads often reached a maximum size of 12.319 cm (4.85 inch.) and "*made of the finest translucent carnelian that it was possible to obtain*" (Mackay 1937: 2).

Mackay found a great variety of unfinished stone beads at various stages of manufacture from Chanhu-daro, which has led to a fair understanding of the mechanism involved in the production of the long barrel-cylinder beads (1937: 3). Agate-carnelian sources have been documented in Gujarat from Ratanpur in Rajpipla, Kapadvanj, Jamnagar, Khandek and Medhok/Mardhak [1] (Bisht 1989:267), and of these many of the agate-carnelian specimens from Harappa were derived from Mardak Bet (Randall, personal communication).

[1] Medhdok, also called as Mardak, is an island in the Little Rann. The name is derived after McMurdoch, who was the Resident in Kachchh and met with his death near this place. It is famous for yielding a huge quantity of carnelian, agate, chert and jasper nodules of various sizes. It commercial importance can be judged by the fact that, in the year 1961 alone, it yielded 10 tonnes of agate. Bisht mentions another site namely, Khandaria mound at village Varanu, probably a late Harappan site, 8 km west from Medhok, which was meant for extracting the raw materials from Medhok. From the waste materials it seems that the late Harappans were involved in the working as well as marketing of the raw materials. The famous Harappan sites of Surkotada and Kanmer are not far the source. Another site to the north-northwest of Surkotada is Khandek, which was another source for agate stones. Some scatter of Harappan and medieval pottery can be seen there.

Mackay also found a large number of stone drills from Chanhu-daro, some broken and some complete, the latter averaging 3.81 cm long, and 2.54 mm to 3.048 mm in diameter (Mackay 1937: 6). He got some of these analysed through the Geological Survey of India that these *"….consist of chert, containing a little magnetite, the hardness of the specimens is 7…..do not occur in nature in this rod-like form; they have apparently been worked into shape from material likely to occur in any of the Archaean rock of India*" (1937: 6). The beads were also bored first and then polished, (Mackay 1937: 9).

The evidence from Shahr-i Sokhta (c. 2700 B.C.) indicates usage of stone drills with tips larger than 1 mm diameter for drilling lapis lazuli beads and other materials, while beads with holes less than 1 mm diameter are also noticed (Kenoyer and Vidale 1992: 499). Shahdad in eastern Iran has yielded the presence of various colours of translucent chert and jasper for drilling small carnelian beads, short truncated bicones in shape (Kenoyer and Vidale 1992: 499).

The drills found from Mehrgarh were termed to be of phthanite as mentioned above. These drills were *"produced from a fine grained jasper-like rock with conchoidal fracture and good chipping properties, distinguished by a uniform light greenish colour"* (Kenoyer and Vidale 1992: 499). The correct identification of the material is yet to be made, and recently Barthelemy and Rodiere have identified pumpelleyite as the mineral in one of the drills (2005: 46).

The excavation at Lothal yielded a bead factory with a working platform and eleven rooms along with two earthen jars containing 582 carnelian beads in one and 212 carnelian, shell and steatite beads (Rao 1985: 580). The complex also brought to light a large number of cores, flakes, ground and unbored bead scatters in the courtyard and the surrounding rooms (Rao 1985: 580). Rao suggests that the agates at Lothal came from Rajapipla mines. He brings to light the similarities between the modern and ancient techniques, including a kiln the precise type of which is still being used for baking pebbles as well as crafted beads; besides the beads found at various stages of manufacture, partly-baked pebbles, fragments of earthen bowls for baking pebbles and finished beads, etc. (1979: 83; 1985: 581).

The beads made at Khambhat are first subjected to the desired shape and polish and then put into drilling of holes. This is very much different from the archaeological record obtained by Mackay at Chanhu-daro. Presently, perforation is made by a diamond-tipped drill, fitted into a wooden shaft, driven by a bow (Possehl 1981: 44). For lubricating the drill movement while in motion, an indigenous arrangement of a small pot with water and grit is made. The flow of water and grit to the point of drilling of beads is regulated by a thin wire connected to the pot (Possehl 1981: 44). The use of a drill, a bow, water and grit as lubricant and abrasion seems to be the same what was adopted by the Harappans, with the only exception that instead of diamond drill, ernestite and chert drill were used by them. Even the seating arrangement of the workers is more or less the same.

Two types of diamond drills were recorded by Kenoyer et al. at Khambhat, namely *tekni* (a single rounded diamond chip to create a depression to facilitate the second drill that makes the actual boring) and *sayedi*, which has two tiny rounded diamonds set at right angles at the tip end (1991: 53). As diamond was unknown during protohistoric period, drills of chert and types of mottled green jasper were in use, and as such much time was consumed in perforation. They estimate that at least two to ten hours would have been required to make a 1 cm of perforation into an agate bead (1991: 54).

Kenoyer and Vidale (1992: 495-518) have suggested two new terms for the identification and classification of cylindrical drills with a dimpled tip, viz. *"tapered cylindrical drills"* and *"constricted cylindrical drills",* as based on the morphology. While the former has a very wide distribution in the regions from Mesopotamia to the Indus, the latter is *"a unique form of standardized and specialized tool developed by the artisans of Indus Valley for perforation of long beads made of agate / carnelian and jasper".* On the basis of a detailed microscopic investigation on a stone drill obtained from Mohenjo-daro, they have proposed to name the unknown material as ernestite"[2] They describe it as, *"….a fine grained metamorphic rock composed primarily of quartz, sillimanite, mullite,*

[2] Kenoyer and Vidale suggested the name "ernestite" as the material of these drills, after Ernest J.H. Mackay, as a temporary name until petrographic studies complete the correct characterization.

haematite and titanium-oxide phases". Of these, mullite is extremely rare in nature, but is produced in modern high temperature ceramic materials (Kenoyer 2003: 73). Kenoyer also suggests that presence of mullite in Harappan drill bits may be as a byproduct due to intentional heating of the original rock (Kenoyer 2003: 73). Ernestite is found in many colours and often multi-coloured ones are also found.

The XRD analysis on Harappa examples indicate that yellow brown matrix is composed of quartzite and sillimanite, while the brown-black portion is primarily of quartz with hematite and some sillimanite / mullite (Kenoyer and Vidale 1992: 506-507). Some peaks of mullite or a yet to be identified intermediary phase are also noticed in the XRD analysis (Kenoyer and Vidale 1992: 507). The electron microprobe X-ray analysis on the yellow brown and brown-black portions indicates a matrix of quartz with iron / titanium oxide phase (Kenoyer and Vidale 1992: 507). They have further suggest that :

(i) concentrations of hematite and iron-titanium oxides give cutting and polishing properties;

(ii) matrix of quartz (probably as quartzite) and sillimanite produces a strongly bonded structure that withstood pressures of drilling;

(iii) abraded surface of the drills retains an irregular surface that facilitates drilling the carnelian, which is less strongly bonded;

(iv) the abrasive quality of the drills is due to the toughness of the sillimanite matrix and concentration of iron-titanium oxides in the rough surface of the drills.

The recent study on the ernestite drills and raw materials is being conducted by Randall as a part of his doctoral research. He describes (personal communication) as:

"Ernestite is an extremely fine-grained stone mottled with dark-brown to black patches and dendritic veins in a khaki-coloured matrix."

He carried out XRD and EMPA studies on four ernestite samples obtained from Mound E of Harappa. The diffraction peaks of two samples indicate that ernestite is composed mainly of quartz and mullite-sillimanite along with minor presence of haematite (iron oxide) and rutile (titanium oxide). The remaining two samples showed the presence of cystobalite and mullite and absence of quartz, haematite and rutile.

He also speculates that ernestite may actually be a variety of claystone known as tonstein that was heated by the Harappan bead makers to high temperatures so that they become extremely hard enough to drill stone beads of high hardness. Two ernestite raw material samples from Dholavira were also subjected to XRD analysis and indicating a pattern similar to other sites (Prabhakar *et al* 2011). Based on the studies of the bead drilling evidences from Mehrgarh and Nausharo, Barthelemy de Saiziue and Rodiere have suggested that four main techniques of perforations can be distinguishable (Barthelemy de Saiziue and Rodiere 2005: 39-48). They have also suggested that the material of the green stone drills previously reported as pthanite is wrong and the mineralogical studies carried out on one sample indicated that the mineral used is pumpelleyite (Barthelemy de Saiziue and Rodiere 2005: 46). Thus it has been observed that no unanimous agreement on the correct identification of the material of these drills has been arrived at so far, with one exception of Mehrgarh evidence. However, the term "ernestite" has gained currency among the investigators in the absence of a correct geological term hence the use of same term in the current study of the Dholavira drills also.

8.4.7 Drills from Dholavira

Dholavira, locally known as Kotada, has revealed a model Harappan city (Bisht 1989: 266). Although highly deficient in most of the minerals, Kachchh is, however, rich in chalcedony, chert, ochres, white clay, Fuller's earth (*mung mitti*), glass-sand, salt, gypsum, different rocks and building materials, many of which may have been exploited by the Harappans (Bisht 1989: 267). Bead making at Dholavira has been attested right from the earliest period onwards (Bisht 1991: 71-82). The bead industry which made its humble beginning during the State I and II, diversified during the Stages III through V, the mature Harappan being represented by Stages IV and V. Stage VI also preserves evidence of bead manufacturing at this site during the late Harappan period.

Also remarkable is the phenomenally large quantity of drills, which have come from different parts of the settlements at this site. However, the Middle Town has yielded the majority of them, thus indicating the concentration of bead industries in that part of the city. The excavations so far have not yielded any kiln

or furnace as evidenced from Lothal, but a lapidary workshop in the middle town has shown up a small fireplace precisely the kind, which is used by the present-day lapidaries at Khambat. Besides, lapidary workshops have been brought to light in the castle and bailey as well. This is accompanied by beads in various stages of manufacturing, bead polishers, drills, etc.A total number of 1603 drills were documented and recorded during the course of the study of the materials from Dholavira excavation. The methodology adopted in the study is presented below.

8.4.7.1 Typology and methodology of documentation of drills

The classification of the drills based on the material is made initially into chert and ernestite. Two examples of vesuvianite drills were also encountered. The drills made out of chert are a very few. However, some chert ones, sometimes accessioned as blades / bladelets / borers, etc., could be drills for making perforation into different media, including wood. A few of them have been dealt with here.

8.4.7.2 Tapered cylindrical drills

The broad drill typology into the "tapered cylindrical" and "constricted cylindrical" drills has been briefly mentioned above. However, the tapered cylindrical drills (fig. 8.138), described by Kenoyer and Vidale, are of the chert and not of ernestite. Kenoyer and Vidale gives the following morphology: Tapered Cylindrical drill has the *"….drilling shaft portion tapered, with the distal end being significantly smaller than the medial portion of the drill bit".* (Kenoyer and Vidale 1992: 500 & 506). These tapered drills were manufactured either from a thin flake or parallel sided blade having a single ridge, which enabled the centering of the drill. Examples of double-ridged blade used for this purpose were also noticed, particularly if the ridges are close to each other. At Dholavira, tapered cylindrical drills of chert are in a very less number for the reasons mentioned elsewhere. However, a large number of tapered drills of ernestite are also noticed.



Fig. 8.138: Examples of tapered drills of chert, Dholavira

The chert drills were sub-divided into unfinished / percoir and finished drills. The finished chert drills were divided into long, medium, short, tapered cylindrical and tapered with dimpled tip. The drills having a length greater than twice its width is termed as long; drills with a length lesser than twice its width or lesser than or equal to its width is terms as medium and drills with a length lesser than its width is termed as short ones.

The other two types are already explained above, viz. tapered cylindrical drills and the ones with a dimpled tip. These two types were not encountered among the chert drills from Dholavira. As noticed above, the tapered drills are devoid of any working on the edges and tip as well. It seems that they were not put into any drilling and hence the chipping, both on the bit portion and base portion is prominently visible.



Fig. 8.139: Examples of tapered drills of ernestite, Dholavira

The ernestite tapered drills from Dholavira have a typical tapering (fig. 8.139) on the bit portion, the surface of which varies according to the amount of drilling that it was subjected to. The surface is chipped, faceted or ground smooth. In contrast, the tang or the base portion retained the original surface of the drill bit before it was put into actual drilling of the beads.



Fig. 8.140: Examples of constricted cylindrical drills of ernestite, Dholavira

The surface of the base portion also varied into chipped, faceted or ground faceted. Two broad variants of the tapered drills are noticed, viz. tapered drills with and without base. Again these varieties have been sub-divided into chipped

and ground drills according to the surface characteristics of the drill bits. For recording purposes, each variety has been given a unique number, which can be seen from the figure on coding types used in the recording of these drill bits.

8.4.7.3 Constricted cylindrical drills

Constricted Cylindrical drill *"….has a long cylindrical shape that is wide at the tip and constricted at the midsection"* and is classified into three parts, namely (i) the distal tip, (ii) the constricted medial portion and (iii) the proximal tang portion (Kenoyer and Vidale 1992: 508).

The constricted cylindrical drills from Dholavira (fig. 8.140) fit very well with the description and morphology provided by Kenoyer and Vidale. The detailed surface morphology and the changes that occur on the drill bits due to drilling have been dealt in detail by Kenoyer and Vidale (Kenoyer and Vidale 1992: 495-518).

The drills from Dholavira of these types are put into two broad categories, first one with base and second, without base. Apart from the tapered cylindrical and constricted cylindrical drills, the other drill types noticed are cylindrical, reused, re-sized and pointed. These are explained one by one below.

8.4.7.4 Cylindrical drills

These types of drills have, more or less, a round section (fig. 8.141), while the surface varies according to the nature and working of them. They do not have a distinct bit and base, but many of the drills exhibit extensive working as reflected on their tips.

The cylindrical drills also include the roughouts that were initially manufactured before putting these drills into actual drilling and perforation of the beads. Hence, depending upon the stages of drilling and finishing of these drill bits, the surface may appear chipped, chipped and ground or ground faceted.



Fig. 8.141: Examples of cylindrical drills of ernestite, Dholavira

8.4.7.5 Re-used and re-sized drills

These are special kinds of drills that are encountered. These types of drills were made from the already available drills, once they were broken at the tips. The broken tips were then worked again, smoothened and made flat and re-used again. In some cases, the base portion was worked upon and used as a drill bit. Both the tapered and constricted cylindrical drills were utilised for such type of re-used drills (fig. 8.142 & 8.142a).



Fig. 8.142: Examples of re-used drills of ernestite, Dholavira



Fig. 8.142a: Examples of re-sized drills of ernestite, Dholavira

The re-sized drills (fig. 8.142a) makes a category by itself. The difference being that the re-sized drills were totally altered and modified into a new one. The bit profile of these drills is also very much different from other ones, and the sides are more or less straight. This is also a state in which, due to the continued drilling of the beads, the profile of the drill changes completely into straightened edges.

8.4.7.6 Pointed drills

This is a unique drill type noticed at Dholavira (fig. 8.143), albeit only one such piece has been documented. The tip portion of the drill bit is pointed and triangular in profile, while the base portion retains a cylindrical shape.

The exact function of this drill type is unknown at this juncture. However, it may be deduced from the working observed on the surface of the drill bit that it had been subjected into drilling extensively and could have produced a bi-conical profile in a bead. It can also be deduced that this particular variety could have been used for small beads.



Fig. 8.143: Example of pointed drill

8.4.8 Methodology of the present study

As explained above, several sub-variants of each type could be noticed and for having uniformity in recording mechanism, a coding system (fig. 8.144) has been developed for each sub-variant. For example, the sub-variant of tapered drills is classified into drills with and without base and then again into those having chipped and ground ones.

Each variant is given a separate code. The tip profiles have also been identified variously as chipped flat, chipped convex, truncated ground, convex ground, convex faceted, flat, flat bevelled, dimpled, dimpled bevelled, nippled, dimple nippled, re-sized, pointed, and faceted have been classified according to the probable occurrences.

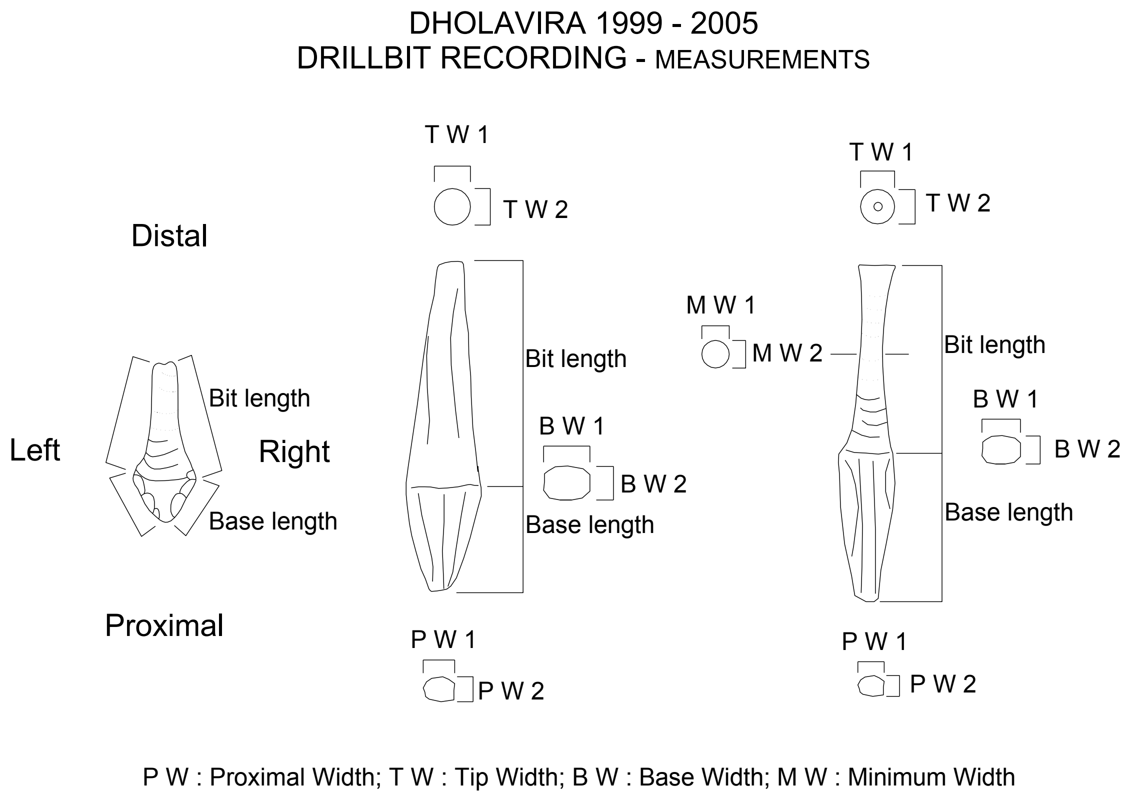


Fig. 8.144: Drill bit recording methodology for measurements

However, it may be pointed out here that all of these varieties were not encountered while documenting the drills. For taking measurements of the drills, various parameters were taken into consideration (fig. 8.145). For examples, two readings each for the tip width, base width, minimum width (in case of constricted cylindrical drills), and proximal width were taken.

The bit length and base length were taken separately. Then the maximum length of the available drill and two readings of the maximum width the drill bit were taken. The maximum thickness was then determined at the opposite direction of the maximum width. Thus a complete drill could be subjected to 13 different kinds of measurements in order to have a complete idea of all the features through proper recording. The following two figures demonstrate the coding system adopted and the measurements that were taken on the drill bits

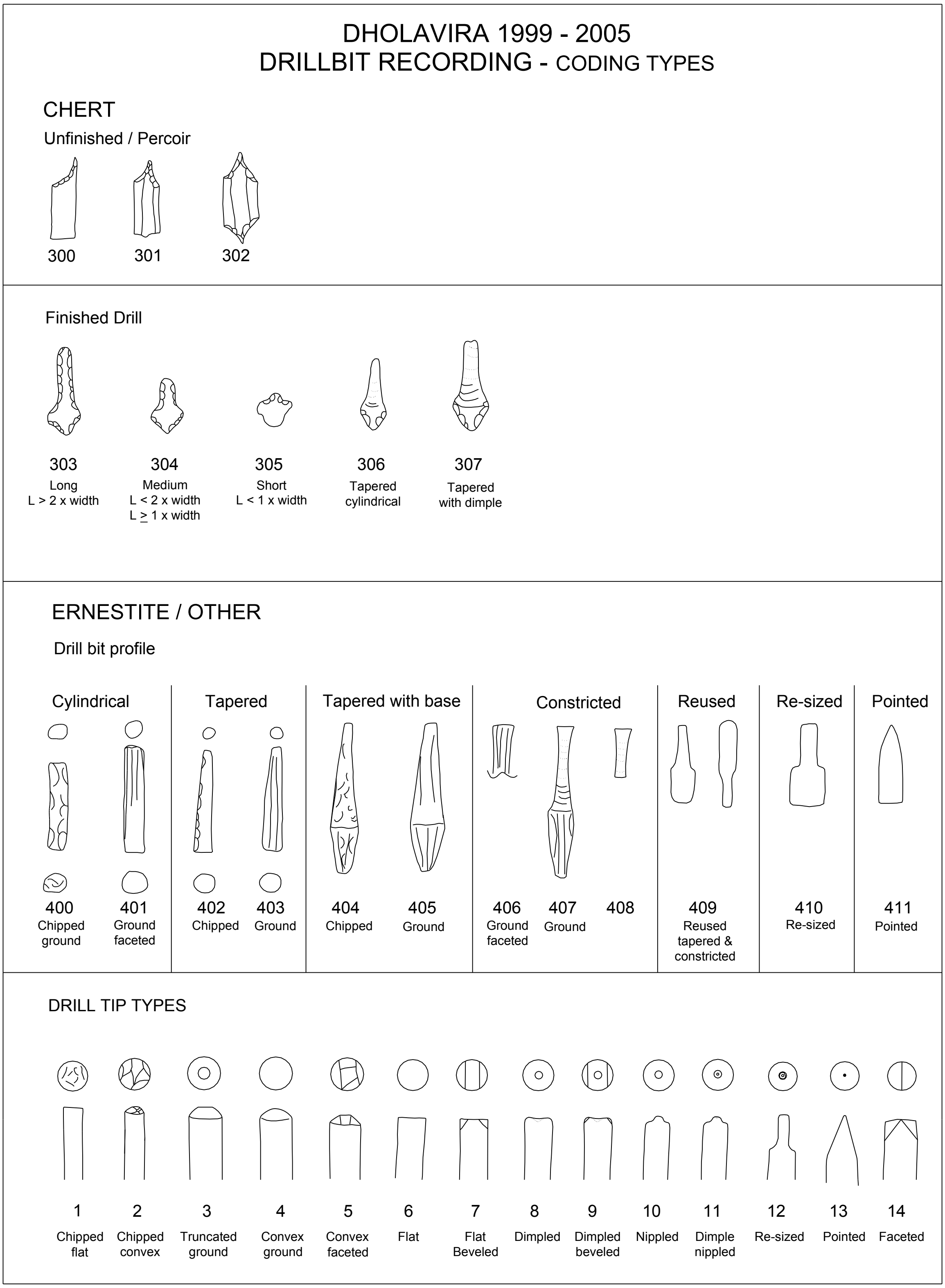


Fig. 8.145: Coding system for recording the drills

. In addition to the above-mentioned parameters and measurement system adopted for recording the drills, the following (fig. 8.145a) were also recorded in terms of state and drill surface of the drills:

STATE	1	= COMPLETE
	2	= MEDIAL
	3	= PROXIMAL
	4	= DISTAL
	5	= NOT DETERMINED
	6	= PROXIMAL – MEDIAL
	7	= DISTAL – MEDIAL
	8	= BROKEN / CHIPPED
DRILL SURFACE	1	= CHIPPED
	2	= CHIPPED AND GROUND (FACETED)
	3	= GROUND – FACETED
	4	= GROUND GROUNDED (NON FACETED)

Fig. 8.145a: Coding for recording state and surface of drill

The state of the drills reflects its nature that was found during the documentation. Similarly, the above parameters for recording the nature of the drill surface were also adopted. The chipped nature of the drill surface indicates that the drill is comparatively an unused one and hence the chipping done for fashioning it is still visible. Chipped and ground (faceted) means that both chipping and minor faceting is observed on the drill surface. Ground-faceted indicates that the drill surface is faceted as well as ground at certain places due to the drilling it already been subjected. The ground grounded (non-faceted) means the drill surface is completely smoothened due to a high degree of drilling, and totally non-faceted.

8.4.8.1 Raw materials for making the drill bits

In addition to the finished / unfinished drills of chert and ernestite, raw materials of ernestite are also noticed in the Dholavira collection. Some of the ernestite raw material nodules are as under:

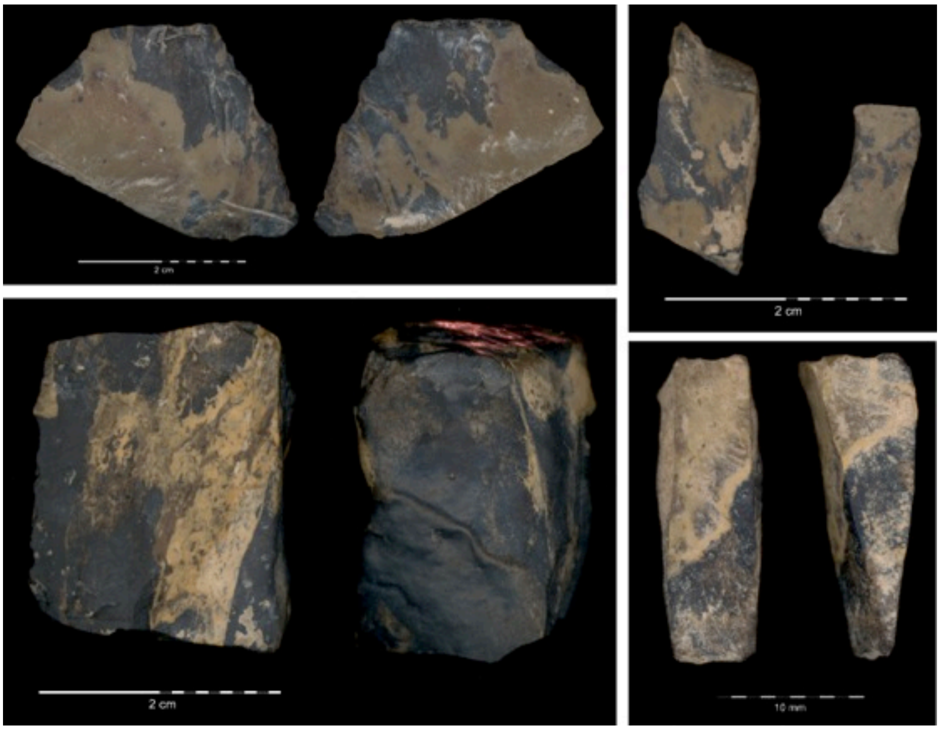


Fig. 8.146: Raw material of ernestite drill

These objects are yet to be analysed in terms of their mineral composition and their comparison with the drills. The future investigations on both the raw materials and drill bits will throw light on the basic mineral composition of different coloured zones. In total, 1603 drills of chert, ernestite and vesuvianite were recorded and documented. The drills were directly scanned on a flatbed scanner at 1200 dpi in groups, generally 20 – 25 in one scan. Then these were cleaned and separated from the group scan and individual images created.

8.4.9 Statistical analysis of the drill bits

Out of the total recorded 1603 drills, 12 are of chert, 2 of vesuvianite and 1 of agate, the remaining 1588 are of ernestite (fig. 8.147). This clearly indicates the preference towards the usage of ernestite drill bits. This could be the reason due to its hardness and suitability for drilling the equally or slightly less hard stones like agate-carnelian, jasper, etc. However, as mentioned elsewhere, drills of chert cannot be ruled out and future works may include those, if any present in the collection. Further, the drills, which are at present on display in the National Museum and at the Interpretation Centre, Dholavira, are also not included in the present study.

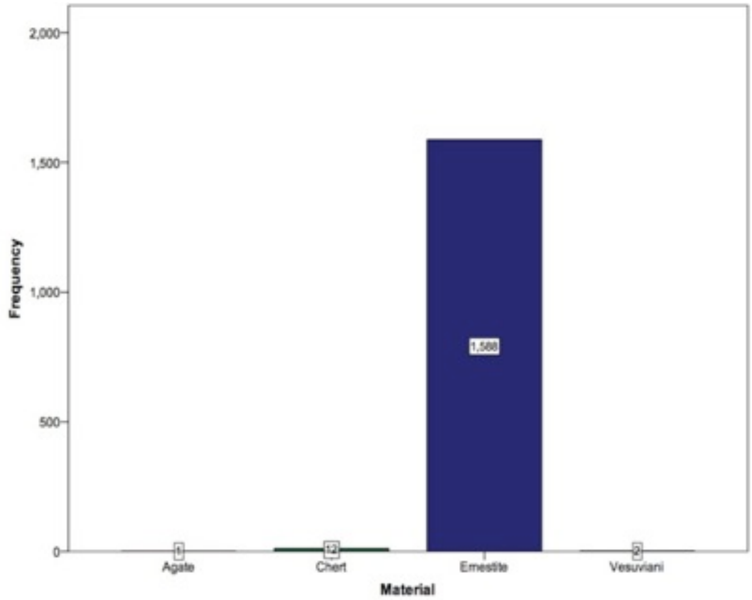
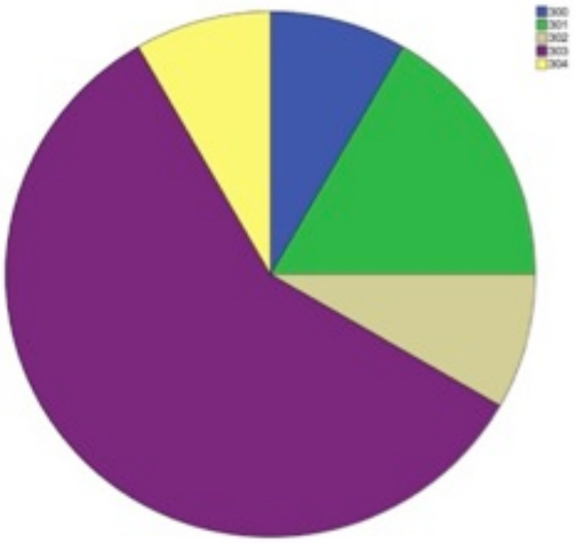


Fig. 8.147: Broad drill types based on material

Thus the ernestite drills represent 99.2% of the total collection, while chert and vesuvianite represent 0.7% and 0.1% respectively.

8.4.9.1 Chert drills

The chert drills represent a very minor portion (12 in total) of the collection as observed above and hence much statistical analysis is not possible. However, with the available examples, an understanding of the pattern could me made.



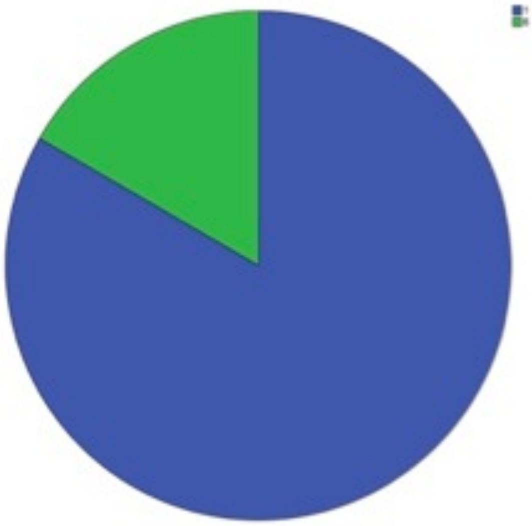


Fig. 8.148: Bit profile (left) and Fig. 8.149: state (right) of chert drills

The long chert drills represent 58.3% of the collection, while unfinished / percoir and medium chert drills represent 33.5% and 8.3% respectively. 83.3% of them are complete ones and 16.7% are proximal-medial ones (fig. 8.148). All the chert drills exhibited chipped drill surface which implies that they were never put into actual drilling (fig. 8.149). The length of the drills vary from 12.98 to 38.09 mm, while the tip width has a range of 1.06 to 2.23 mm. The bit length range from 8.49 to 16.72 mm; base length from 4.49 to 12.73 mm. The base width range from 2.22 to 4.95 mm; proximal width from 1.22 to 5.65 mm. The absence of evidence for drilling on the surface of drills is rather surprising, however, keeping into mind the very less dataset represented by the chert drills, this fact can be understood.

8.4.9.2 Ernestite drills

Percentage-wise break-up of ernestite, chert and vesuvianite is already given above under point 5.

8.4.9.2.1 Spatio-temporal analysis of the drills

Out of the total 1593 drills which were analysed, the spatio-temporal analysis could be carried out for 1470 drills as only the drills with the location details pertaining to castle, bailey, middle and lower towns were taken into account. These localities broadly constituted the occupational area and the remaining finds from other localities may be due to re-deposition or erosion and other causes, although possibility cannot be ruled out that other spaces like the banks of water tanks or other open areas may have also been use for bead making purposes. Of these 1470 drills, 5 each belong to stages II and III, 271 to stage IV, 947 to stage V and 243 to stage VI. In terms of locality of these drill finds, 161 are from bailey, 318 from castle, 69 from lower town and 922 from middle town. The data from the analysis is also represented in the form of a chart (fig. 8.150). This clearly indicates that the bead manufacturing industry using ernestite drills was dominant during stages IV and V from the middle town locality. This also holds good in terms of the amount of manufacturing debitage.

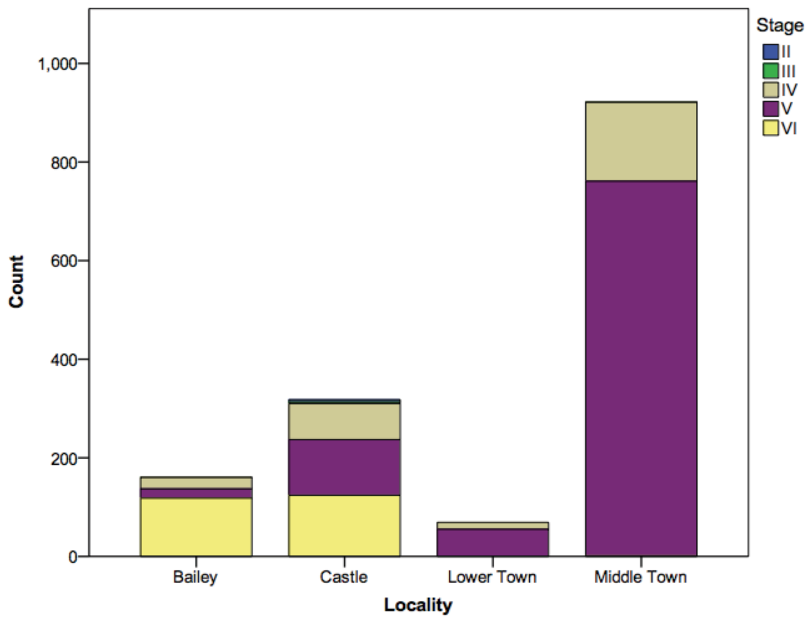


Fig. 8.150: Spatio-temporal distribution of ernestite drills

8.4.9.2.2 Bit profile

The bit profile is the classification of the drills based on the morphology. Thus the broad classification of the drills has been made to cylindrical, tapered cylindrical, constricted cylindrical, re-used, re-sized and pointed. There are other sub-variants among the first three varieties, which have been clearly shown in the figure showing coding types. A percentage-wise distribution of the bit profile from the collection (fig. 8.151) are given as tapered cylindrical and ground (39.8%); cylindrical and ground faceted (19.8%); constricted cylindrical without base and ground (14.2%); constricted cylindrical with base (4.9%); tapered cylindrical without base (16.1%); cylindrical and chipped, ground (2.7%); re-used (1.6%), re-sized (0.4%), constricted cylindrical, ground faceted (0.3%); pointed and tapered, chipped (0.1% respectively).

Keeping aside the sub-variants in the bit profile the tapered cylindrical drills represent 55.9% of the total collection followed by cylindrical drills (22.5%), constricted cylindrical drills (19.4%). It is interesting to note that a documentation of an additional 386 drills when compared to 1202 drills in the previously published results (Prabhakar 2012) has modified the results in terms of bit profile to a greater extent.

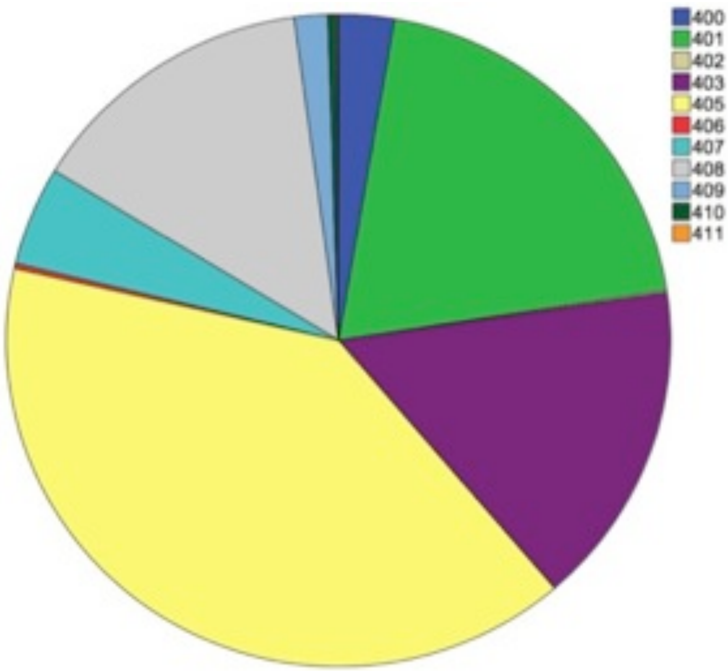


Fig. 8.151: Bit profile of ernestite drills

The percentage of tapered drills without base has risen considerably from 3.6% to 15.9% while the tapered cylindrical and ground faceted has dropped from 52.5% to 39.8%. However, the total percentage of tapered cylindrical drills still dominates and accounts to 56.9% of the total drill collection, even though the latest documenation indicates a drop of 0.3% as compared to previous results, which is marginal.

This type of drills are of all sizes and could be more suitable for shorter beads and to make initial perforation in long beads. Thus, there are three types which constitute 97.5% of the ernestite drills as documented from Dholavira, while the minor types like re-used, re-sized and pointed drills account for the remaining 2.5%.

8.4.9.2.3 State

As described above, the state represents the nature of the drills, whether it is complete or broken or partly preserved. The following pie chart (fig. 8.152) shows the percentage of various states of the drills.

The complete and finished drills constitute 39.4% of the total collection, followed by proximal-medial (32.6%), distal (17.3%), medial (6.9%), distal-medial

(3%), not determined (0.6%), proximal (0.3%) and broken-chipped (0.1%) ones. The complete ones are followed by the proximal-medial drills which represent 32.6% of the total collection.

However, if we take into account the incomplete and broken ones accounting for 60.6%, it clearly indicates that they are used and broken drills. Many of these drills show breakage due to extreme pressure, or twisting while drilling. While these varieties can be interpreted as remains of extensive industrial activities, the complete ones preserve excellent examples of various stages in the usage of drills.

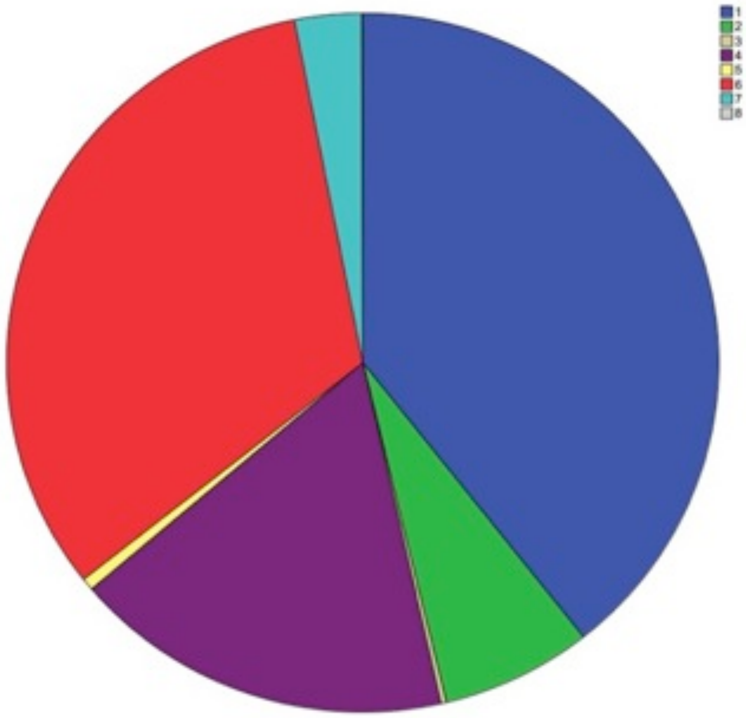


Fig. 8.152: State analysis of ernestite drills

The complete drills have examples of unused faceted ones which is an indication of the first stage in the finishing of a drill before it was put into use. The subsequent drilling mechanisms clearly left a mark on the surface of the drills corresponding to the perforation made on the bead blanks. The continous to and fro mechanism left erosionary marks on the surface of drills as well as the tips, the latter facing the brunt of drilling mechanism.

8.4.9.2.4 Drill surface

The drill surface indicates the actual working or non-working evidences on the drills. The fig. 8.153 shows the respresentation of various drills into different drill surfaces. Thus, it can be observed that an overwhelming 76.6% of the drills have a ground-grounded(non-faceted) drill surface, i.e. a very smooth and polised surface due to the extensive use of these drills for making perforation in the beads. The complete smooth surface of the drills is followed by other types like ground-faceted (15.5%), which is a partially smoothened and partly faceted surface, that can be interpreted as an intermediary stage of the extreme working and very less working of these drills.

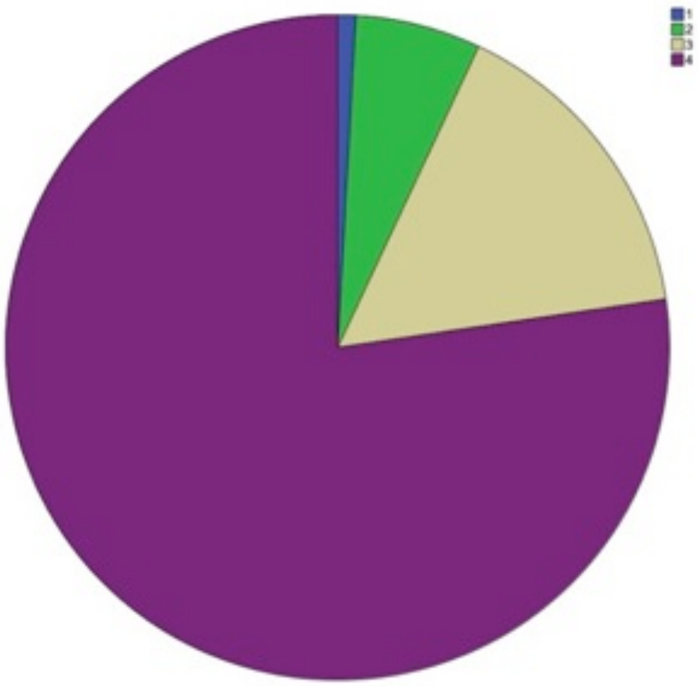


Fig. 8.153: Drill surface of ernestite drills

Hence, this type can also be added to the ground-grounded variety if we are to interpret the evidence for actual working of the drills. The other varieties of the drill surface, namely chipped and ground (6.1%) and chipped (0.9%) constitute a very minor percentage in the total collection. Thus, it can be observed that 92.1% of the drills were actually worked upon and used for either making perforation or used as pivots.

8.4.9.2.5 Tip profile

The tip profile is the state of the drill tip that is modified due to the stages of working. The tip of the drills is initially chipped flat and then due to various stage of drilling, the tip surface is constantly modified / altered. Thus various variants like truncated ground, convex ground, dimpled, nippled, dimpled and nippled, pointed, etc., are noticed. The drills might have been used for making perforation on a variety of materials including wood, shell, pottery, bone and various stones like lapis lazuli, steatite, haematite, sandstone and siliceous rocks (Kenoyer and Vidale 1992: 504). It has also been interpreted that when the tip of the tapered cylindrical drills becomes cylindrical, it is of no use on softer materials, but still can be used on harder rocks (Kenyer and Vidale 1992: 504).

The studies on the drills and experimentation by Kenoyer and Vidale indicate that initially the tip of the drills is jagged and, due to repeated drilling on the harder materials, it becomes rounded and polished and loses its abrasive and cutting power (Kenoyer and Vidale 1992: 505). Hence, the tip of the drills have to be constantly flattened, cleaned and used for drilling again, and thus a concave depression is formed due to the dynamism involved in the drilling, as well as repeated flattening and usage (Kenoyer and Vidale 1992: 505).

The tips of the constricted cylindrical drills are also flat with the edges faceted, and with a flattened oval shaped distal end which is transformed into a rounded one with a concave dimple at the centre due to repeated drilling (Kenoyer and Vidale 1992: 509). The concave dimple surface of the drill tip makes it difficult for further drilling and hence the tip edges has to be repeatedly faceted so as to attain additional cutting potential (Kenoyer and Vidale 1992: 509). The pie chart (fig. 8.154) indicates the representation of various tip profiles across the collection. The percentage-wise distribution is also indicated below. In addition to the coding types used here starting from 1 to 14, another type named ‘0’ is also used as a post-recording coding to represent the absence of / broken tip. The above pie-chart shows that a large portion (40.2%) of the drills are devoid of drill tip, thus indicating that a large number of discarded drills are represented in the collection.

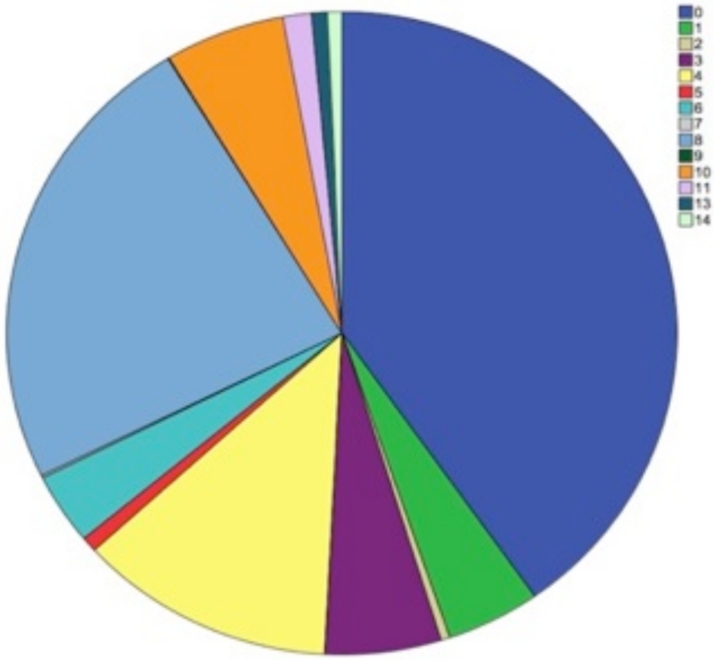


Fig. 8.154: Tip profile of ernestite drills

The other tip types represented comprise chipped flat (4.5%), chipped convex (0.4%), truncated ground (5.6%), convex ground (12.4%), convex faceted (0.8), flat (3.6%), flat beveled (0.08%), dimple (23.6%), dimple beveled (0.1%), nippled (5.8%), dimple-nipple (1.4%), pointed (0.8%) and faceted (0.7%). Of the drill that has a clear tip, the dimple tip profile dominates.

It represents 23.6%, followed by convex ground, which is 12.4% of the collection. The analysis of the bit profiles individually will further present a clear picture regarding which tip profile is distributed among various bit profiles. That will help us understand the correct context of the dimple tip profile, as it has been deduced by Kenoyer and Vidale that this stage represents the repeated usage of the drill and before it is again put into effective drilling, the tip surface is faceted. The constricted cylindrical drills dominate the tip profile represented by dimpled ones, followed by tapered cylindrical and cylindrical ones.

The recording methodology consists of initially documenting the drills on the basis of surface characteristics, morphology and physical appearance. Then the various measurements of the drills were taken which consisted of maximum length, maximum width and thickness, bit length, base length, two readings each of tip width, minimum width, base width and proximal width. The average of each

of the two readings taken on tip, minimum, base and proximal widths were also taken before doing the statistical analysis. The various readings taken for all the drills are given at the end. Based on the recordings taken on the various drill bits, the various distribution patterns are given here, while these will be done again for each of the bit profile later.

8.4.9.2.6 Maximum length

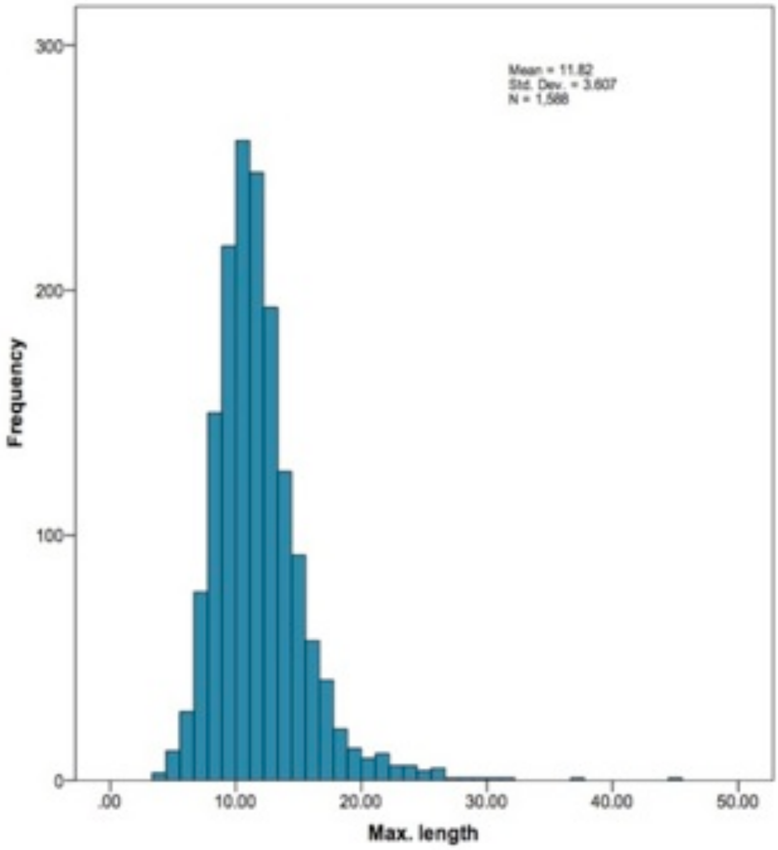


Fig. 8.155: Histogram of maximum length of ernestite drills

As mentioned elsewhere, a total number of 1588 ernestite drills have been documented and the histogram of the maximum length of all these drills is given in (fig. 8.155). As all the drills include that of broken and incomplete ones also, the range of maximum length has a wide range. The length of these drills varies from a minimum of 3.34 to a maximum of 45.11 mm. The mean length of the drills is 11.82 mm with a standard deviation of 3.607 mm. From the histogram it is obvious that most of the drills fall between 8 and 15 mm and nearly 260 drills

have a maximum length between 11 and 12 mm. The drills having a maximum length of 20 mm and above are very few in number, and four drills have been noticed with lengths above 30 mm, while one drill has a length of 45 mm.

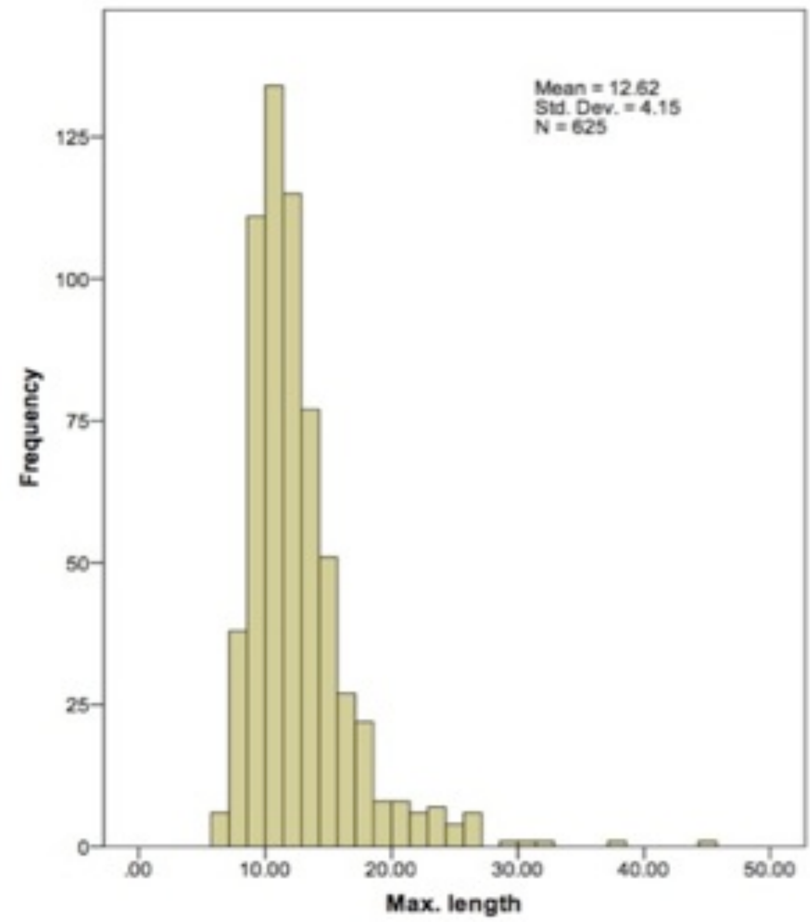


Fig. 8.156: Histogram of complete drills for maximum length

If we take into account only the complete drills for measuring the maximum length, 625 samples were available out of the total 1588 drills. The length of the complete drills varies from 6.07 to 45.11 mm. The mean length of the complete drills is 12.62 mm with a standard deviation of 4.15 mm. The histogram of the maximum length of complete drills (fig. 8.156) indicates that most of the drills have a length between 8 to 14 mm and nearly 135 drills have a length between 11 and 12 mm. This corresponds well with the histogram of maximum length of all the drills.

8.4.9.2.7 Average width

The recording methodology of the width of the drills involves taking of two readings, the first one taken at the point of maximum width and the second one with the next maximum thickness. Hence the average width of the drills is the mean of these two readings. The dataset for 1587 drills is available for the average width. The histogram of the average drills (Fig. 8.159) indicates that the mean width is 2.861 mm with a standard deviation of 0.508 mm. The width varies from a minimum of 1.245 mm to 6.885 mm.

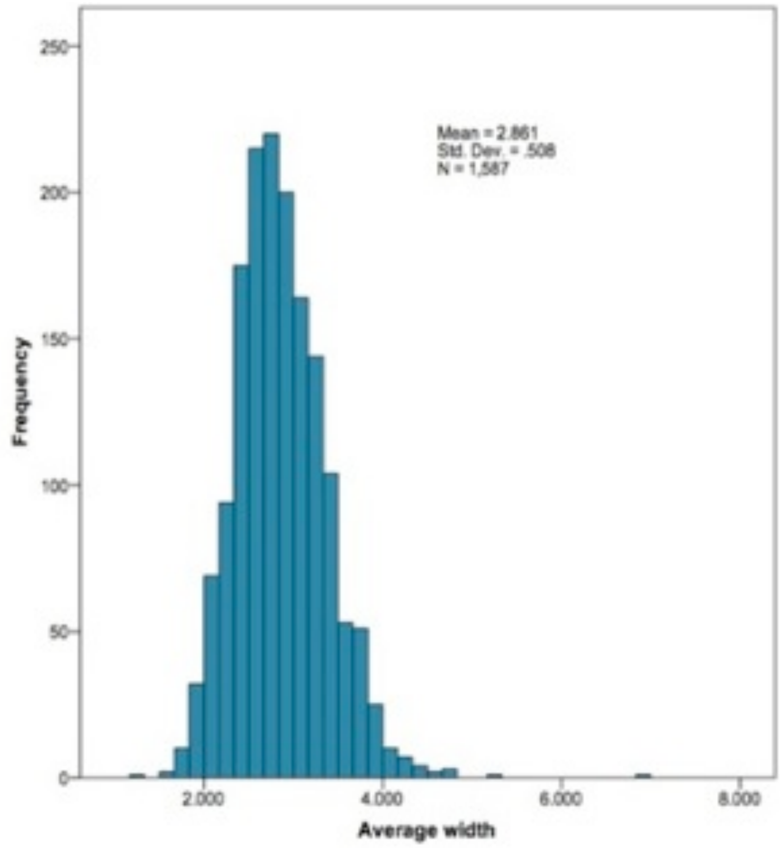


Fig. 8.157: Histogram for average width

The majority of the drills have a width between 2 and 4 mm. Drills having a width of above 4 mm and below 2 mm are very meagre and they constitute a minority. Only one example has an average width of above 6 mm and there is also one example having a width around 1 mm.

8.4.9.2.8 Bit length

As indicated elsewhere, complete drills constitute 39.4% of the total drills recorded from Dholavira. Only these complete drills and having a conspicuous bit is utilised for the analysis. A total of 656 drills having such evidence could be found out. The histogram derived from the available complete drills is given at Fig. 8.158. The mean bit length of the analysed drills comes to 8.43 mm with a standard deviation of 4.567 mm.

The bit length varies from a minimum of 2.44 mm to 45.11 mm. It may be pertinent to mention here that the maximum bit lengths are observed from the cylindrical drills, as the length of complete drill has been assumed as the bit length in such cases in the absence of a clear-cut bit surface.

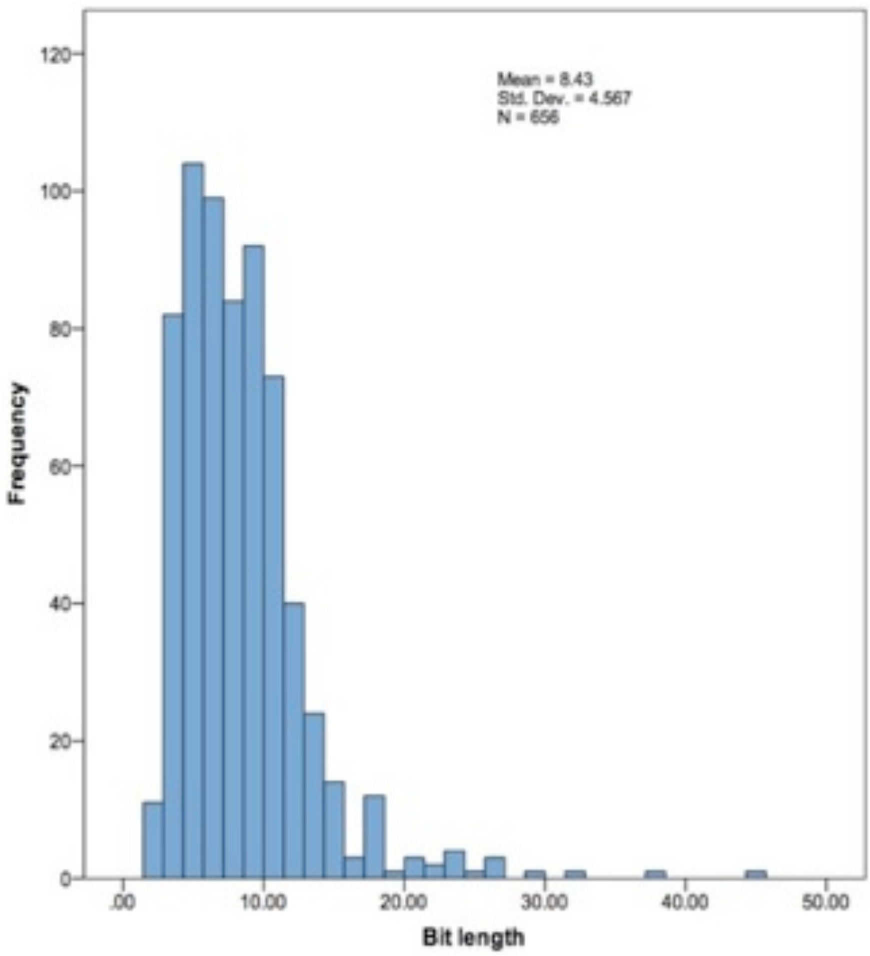


Fig. 8.158: Histogram of bit length

8.4.9.2.9 Base length

The base length is measured from the point where the evidence of drilling ends and un-worked surface emerges up to the proximal end. A total of 873 drills have evidence of a clear base length and they were utilised for the analysis and a histogram created. The base length varies from a minimum of 0.31 mm to a maximum of 18.77 mm.

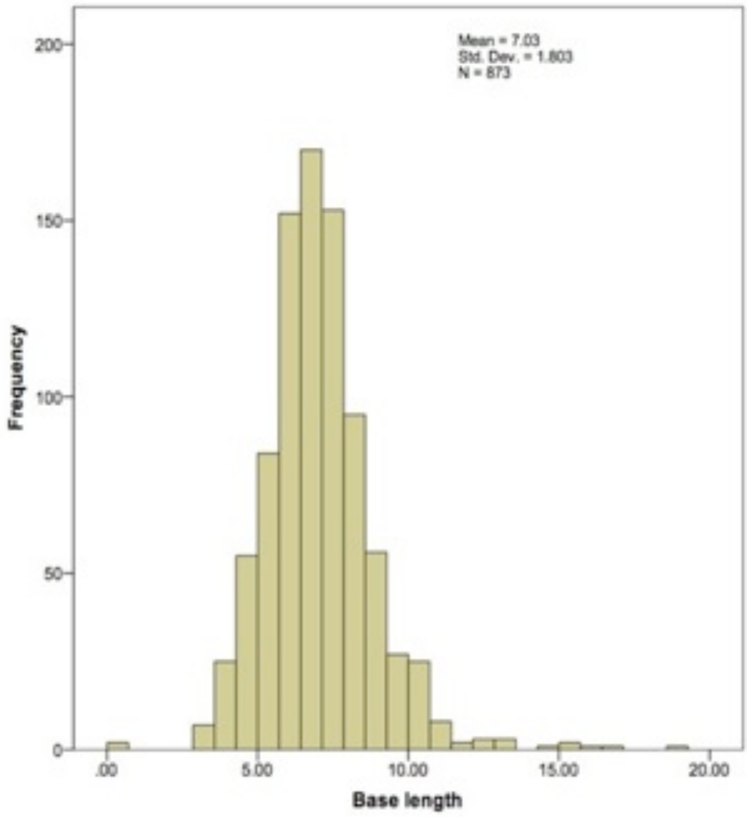


Fig. 8.159: Histogram of base length

The histogram (fig. 8.159) indicates that the mean base length is 7.03 mm with a standard deviation of 1.803 mm. A majority of the drills have a base length ranging between 5 mm and 10 mm, with a clear presence of drills having a base length between 7 and 8 mm. The drills having a base length of 15 mm and above are very few and constitute a minor percentage in the collection.

8.4.9.2.10 Tip width

The tip of a drill is the actual working edge and it clearly demonstrates the evidence of various working stages involved in the actual perforation of various mediums. The various stages that emerge on the tip due to this working are

explained elsewhere. A total of 940 drills with a tip are used for carrying out the analysis of the variations in the tip width. Here too, two readings perpendicular to each other at the tip end are taken and the mean of these are taken for creating the histogram.

The histogram (fig. 8.160) indicates that the mean tip width of 940 drills is 2.4 mm with a standard deviation of 0.533 mm. The tip width ranges from a minimum of 0.79 mm to a maximum of 5.37 mm. The tip widths ranging from 1.8 mm to 3.6 mm constitute a major percentage of the drills and this is also a clear indication of the diameter of the perforation made on the actual bead. Tip widths of 4 mm or above constitute less than 1% in the collection.

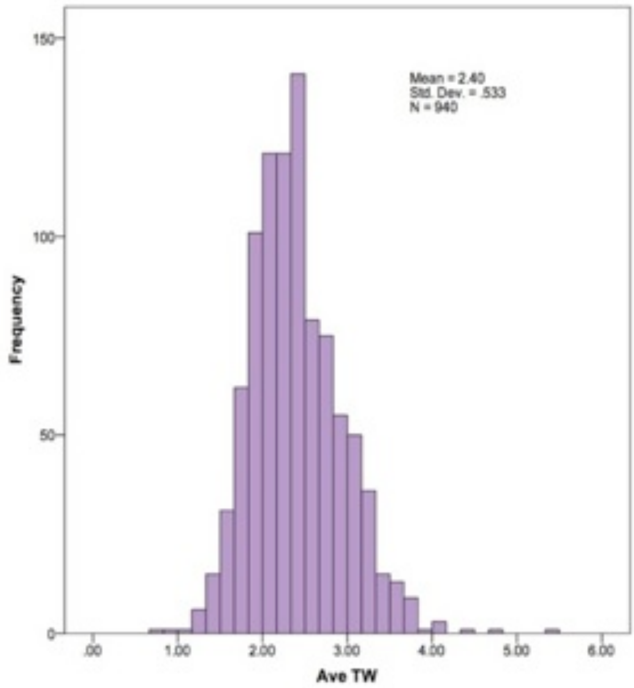


Fig. 8.160: Histogram of tip width

8.4.9.2.11 Minimum width

Minimum width is a unique physical property of the constricted cylindrical drills, which forms part of it and played a very major role in the perforation of long beads. The Harappans invented this type of drills and fashioned them purposefully in order to make a longer perforation that was not possible with other types of drills. The reading is taken at the constricted portion between the tip and

the base of the bit shaft of the drill, and at the minimum point. Again two readings were taken and average of them is deduced for analysis.

The histogram (fig. 8.161) created using a sample size of 256 drills that were left with the constricted portion indicates that the mean minimum width is 2.033 mm with a standard deviation of 0.373 mm. The minimum width varies from 0.99 to 3.155 mm. An overwhelming percentage of the total collection has a minimum width ranging between 1.4 and 2.9 mm. The mean of the minimum width (2.033 mm) very well corresponds with the mean of tip width, which is 2.4 mm.

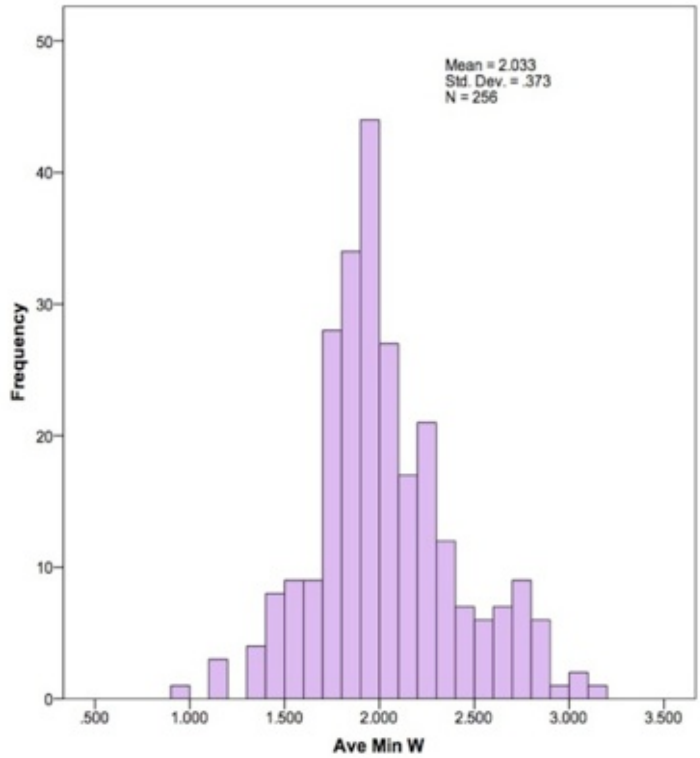


Fig. 8.161: Histogram of minimum width

It may, therefore, be deduced that tip width and minimum width between 2 and 2.5 mm were preferred most by the Harappans in fashioning the constricted cylindrical drills and ultimately the diameter of their long barrel beads also falling in this range. Measuring the various examples of long barrel cylindrical beads and other long beads available from Dholavira may help in further understanding of this pattern.

8.4.9.2.12 Base width

The base width is taken at the point where the base of a drill starts. As the general pattern, here also two recordings are taken perpendicular to each other. The histogram created (fig. 8.162) from the 959 drills, which have a clear base width, shows that the mean base width is 2.73 mm with a standard deviation of 0.398 mm. The histogram also clearly shows that a major percentage of the drills have a base width ranging from 2.2 mm to 3.4 mm.

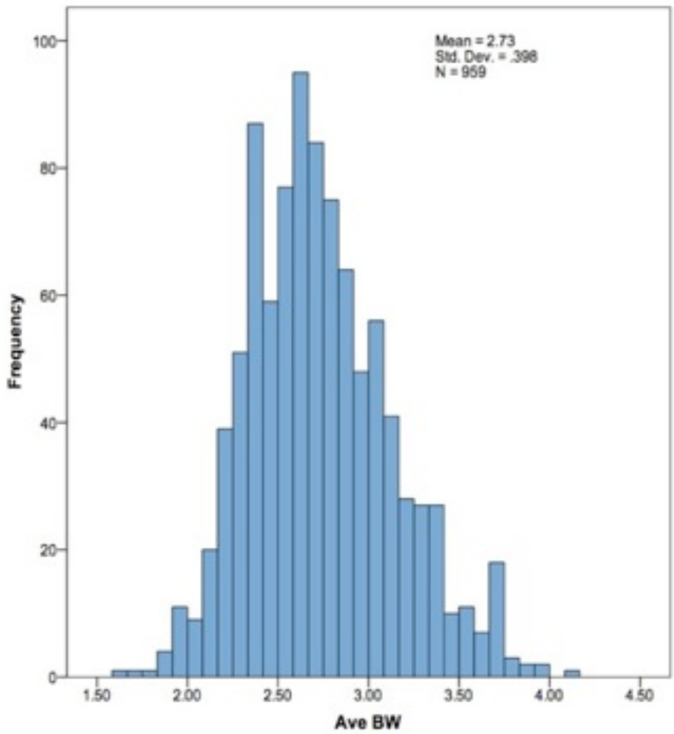


Fig. 8.162: Histogram of base width

The base width has a range starting from a minimum of 1.63 mm to a maximum of 4.15 mm. The drills with a base width less than 2 mm and more than 3.5 mm constitute a minor percentage of the total collection.

8.4.9.2.13 Proximal width

The proximal end is the opposite end of the tip-end that is hafted into the wooden shaft for driven by a bow drill. Here too, two recordings are made and mean of them is taken for the analysis. The histogram created using 1132 drills having a clear proximal end shows that the mean proximal width is 2.48 mm with a standard deviation of 0.438 mm. A major percentage of the drills have a

proximal width falling between 2 and 3 mm. The minimum proximal width recorded is 0.975 mm while the maximum one is 5.245 mm. The example with a width of 5.25 mm is an isolated one as is observed from the histogram. Otherwise all the other examples have a width less than 4 mm, and a minor percentage have a width ranging between 3 and 4 mm as well as 1 and 2 mm.

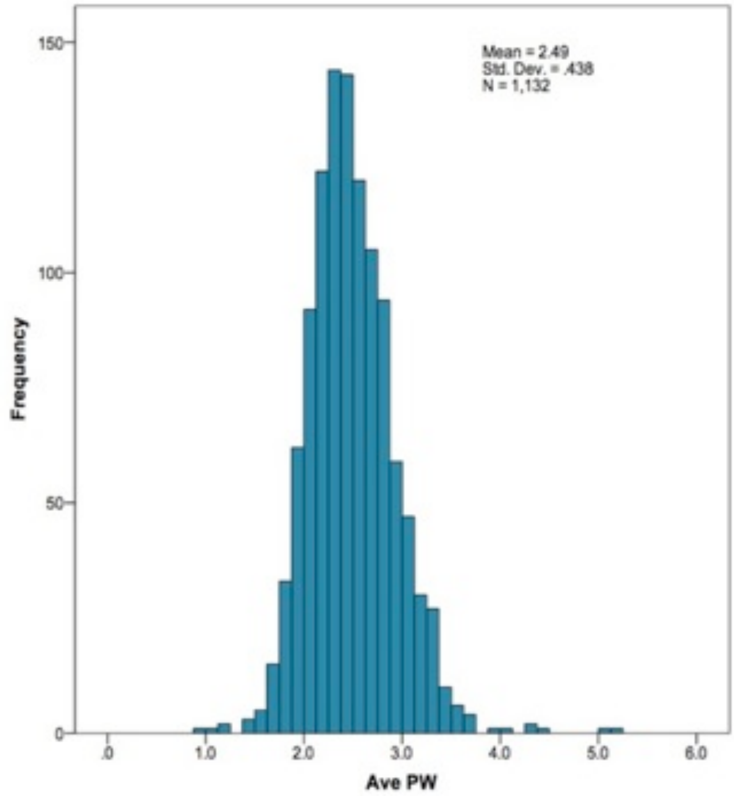


Fig. 8.163: Histogram of proximal widt

8.4.10 Statistical analysis of individual drill types

8.4.10.1 Cylindrical drills

The cylindrical drills constitute 22.5% of the total collection of ernestite beads. A spatio-temporal analysis of cylindrical drill from different cultural stages and localities of Dholavira is shown at fig. 8.164.

The spatio-temporal analysis indicates that the number of cylindrical drills at localities like castle, bailey, middle town and lower town is 74, 56, 184 and 1 respectively. The drills, when compared between different cultural stages, have a count of 2, 1, 44, 201 and 79 for Stages II, III, IV, V and VI respectively.

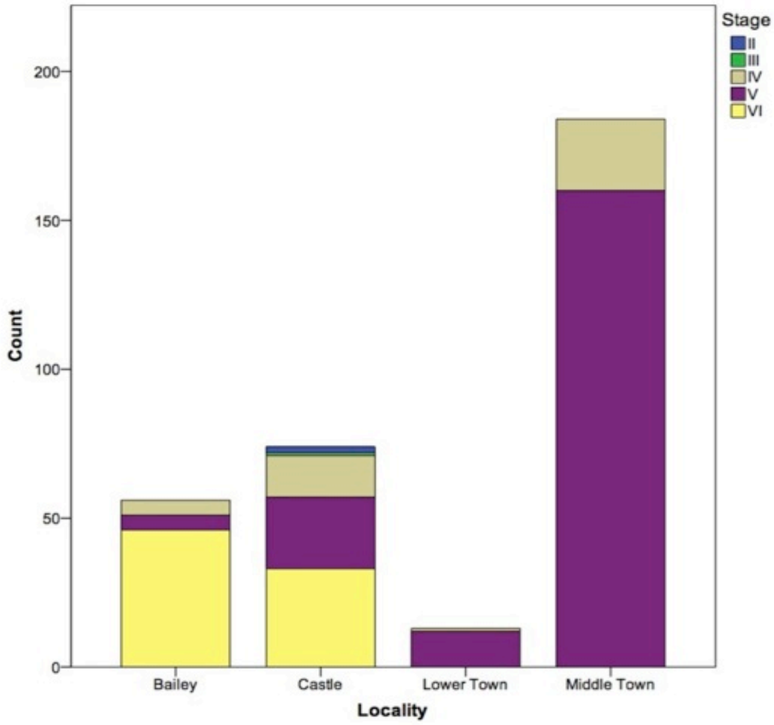


Fig. 8.164: Spatio-temporal analysis of cylindrical drills

The spatio-temporal analysis for cylindrical drills also corresponds to the analysis for the entire drill bit collection and clearly indicating the middle town as the central focal point of bead manufacturing during the mature Harappan period represented by Stages IV and V as well as in the preceding Stage III.

Out of the total 358 drills of this variety available for analysis, 43 are of cylindrical-chipped ground and the remaining 315 of cylindrical-ground faceted. The state of the cylindrical drills indicate 68.7% of the collection as complete specimens while the remaining are represented by fragments such as medial (11.2%), distal (7%), proximal-medial (5%), distal-medial (4.7%) and minor percentages of other varieties like proximal (0.8%) and broken / chipped (0.3%). A look into the condition of drill surface indicates that 53.6% of the drills are ground faceted followed by chipped and ground (faceted) (24.6%), ground grounded (not facetted) (18.4%) and chipped (3.4%) varieties.

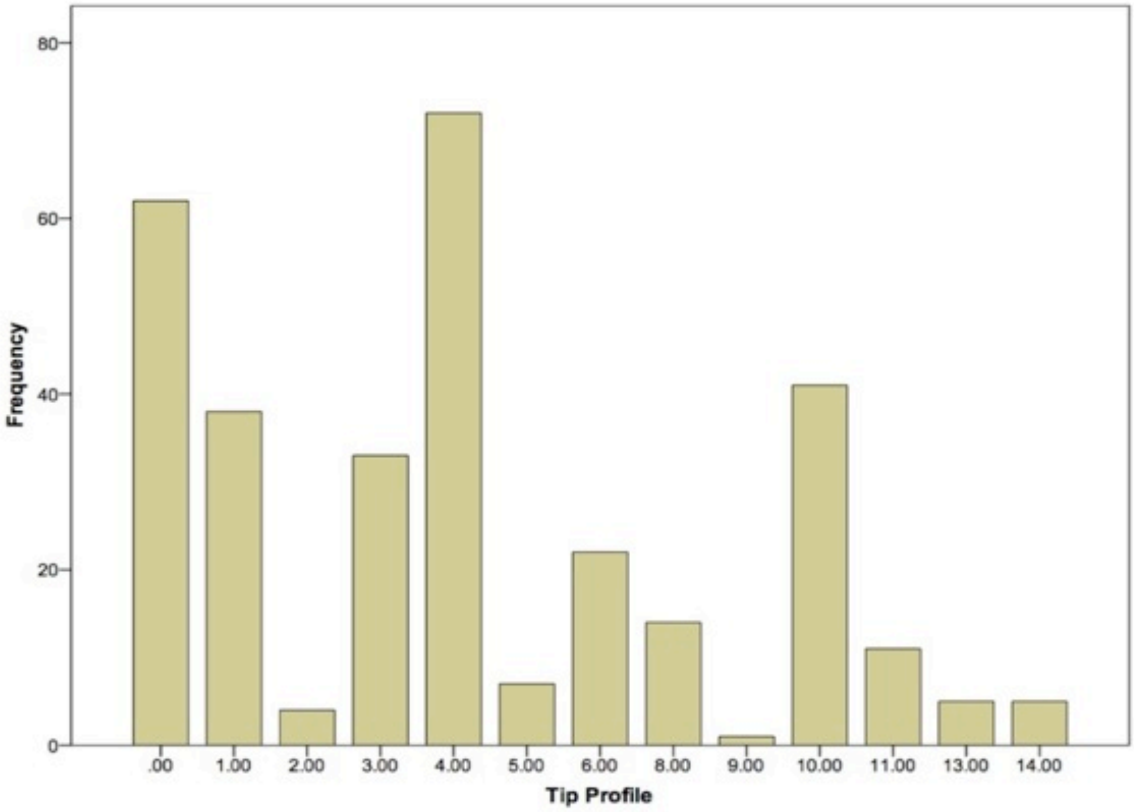


Fig. 8.165: Tip profile of cylindrical drills

The tip profile analysis (fig. 8.165) of the cylindrical drills has demonstrated that 22.9% of the tips are convex ground, followed by broken tips (19.7%), nippled (10%), chipped flat (12.1%), truncated ground (10.3), flat (7%), dimpled (4.4%), dimple-nippled (3.5%), convex faceted (2.2%), pointed & faceted (1.6% each), chipped convex (2%) and dimple bevelled (0.3%). The first four dominant percentages of tip profiles is a clear indicator of considerable working of the drills after which such tips are formed due to surface modifications. The cylindrical drills, 358 in number, were also analysed in terms of length, width, tip width, etc., as it had been done for the overall drill collection. The maximum length of the cylindrical drills varies from 4.39 mm to 45.11 mm, while the mean length is 11.76 mm with a standard deviation of 4.571 mm.

The histogram (fig. 8.166 for the maximum length also suggests that a majority of the drills fall between a range of 6 and 15 mm with the peak being 9 –

11 mm. The length of drills above 30 mm is extremely rare with only 3 numbers falling in this range, while only one drill is above 40 mm with a length of 45.11 mm which is the maximum length of any type of drill noticed at Dholavira and is of the cylindrical variety.

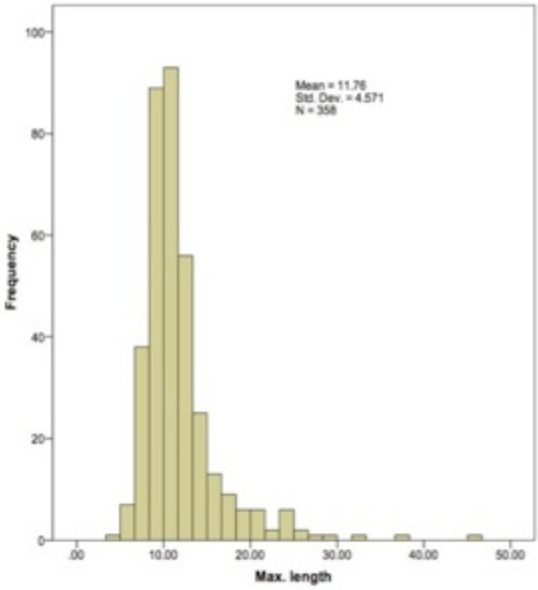


Fig. 8.166: Histogram of maximum length

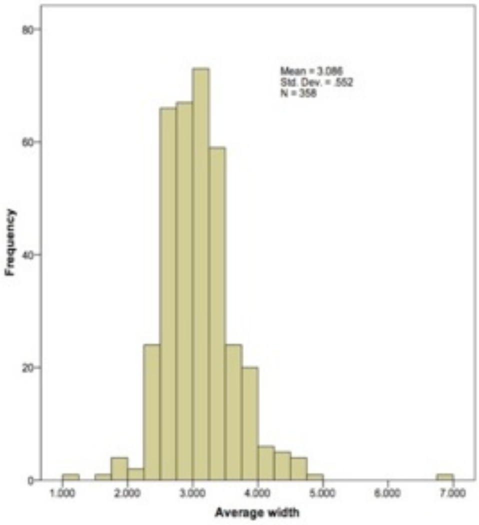
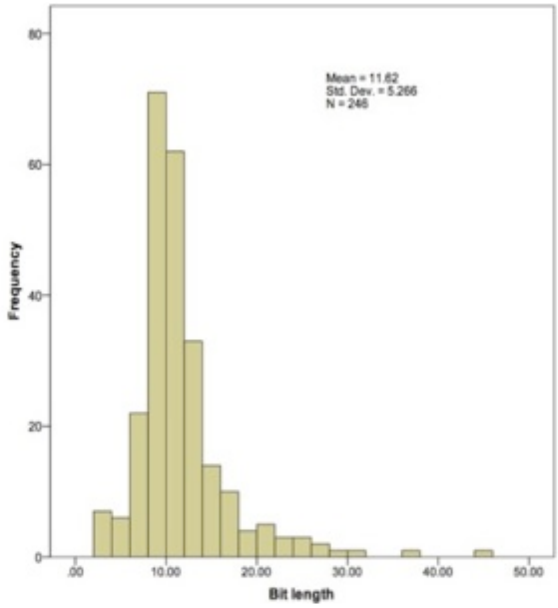


Fig. 8.167: Histogram of average width

The average width analysis (fig. 8.167) is also similar to all 358 cylindrical drills for which the results could be obtained. Further the average width falls between 1.245 and 6.885 mm with a mean of 3.086 mm with a standard deviation of 0.552. Whereas the majority of the drills have a width of 2.4 to 4 mm, those with the width between 4 and 5 mm are rare - only one specimen with a thickness of 6.885 was noticed. The next category of analysis consists of bit and base lengths. The bit length (fig. 8.168) could be measured for 246 drills and they range between 2.84 and 45.11 mm with a mean of 11.62 mm and a standard deviation of 5.266. A majority of the drills have length around 10 mm with only one above 40 mm. The base could be noticed in only 23 drills of this variety. The length of base varies between 3.4 to 10.04 mm with a mean of 5.36 mm and a standard deviation of 1.589 mm.



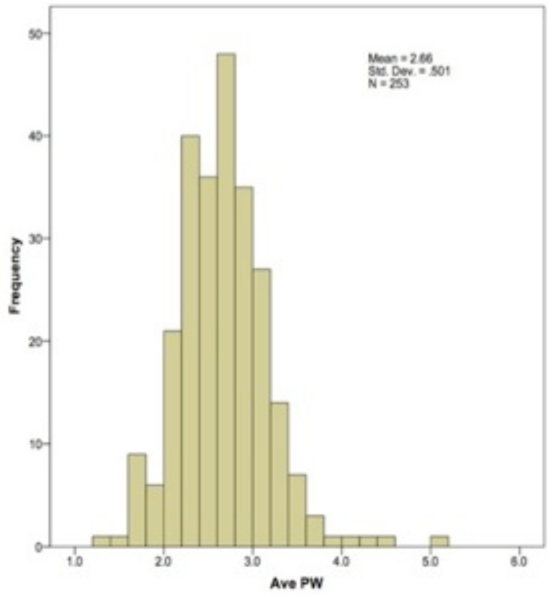


Fig. 8.168: Histogram of bit length

Fig. 8.169: Histogram of proximal width

In the case of 281 drills the average tip width ranges between 1.06 and 5.37 mm with a mean of 2.82 mm and a standard deviation of 0.515 mm, while a majority of the drills have an average tip width from 2 to 3.8 mm. The base width in the case of 41 drills range from 2.29 to 3.39 mm, with a mean of 2.83 mm and a standard deviation of 0.366 mm. The proximal width (fig. 8.169) of the drills range from 1.235 to 5.07 mm, with a mean of 2.66 mm and a standard deviation of 0.501 mm.

8.4.10.2 Tapered cylindrical drills

The tapered cylindrical drills which constitute 55.9% is the dominant variety. Of those 71.3% have a base while those remaining are without a base. These two varieties have been taken up for analysis for determining various parameters. The spatio-temporal analysis of tapered cylindrical drills again shows that the majority of the drills pertain to the mature Harappan period and middle town yields the most of them. A detailed break-up of the drills stage-wise and locality wise is given below:

Count	Stage	Count	Locality
3	II	79	Bailey

2	III	177	Castle
152	IV	37	Lower Town
550	V	536	Middle Town
122	VI		

The stacked bar chart of the above details is at fig. 37.

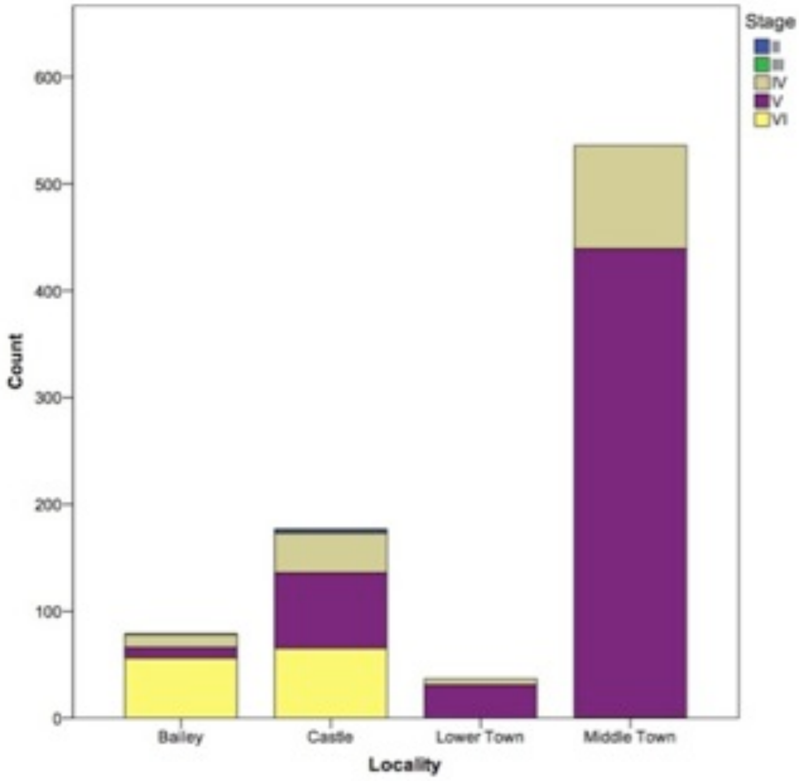


Fig. 8.170: Spatio-temporal analysis of tapered cylindrical drills

The fig. 8.170 clearly points towards the shrinkage of the occupation areas which became confined only to the castle and bailey and the southern margin of the middle town during Stage VI. The tapered cylindrical drills when subjected to analysis for the state of preservation (fig. 8.171) indicate that 54.6% of them are proximal-medial, which is a clear indicator of industrial residue, as the tips were broken in a majority of the cases. This state is followed by complete (32.6%), medial (6.5%), distal (3.7%), distal-medial (2.7%). Thus, it can be observed that except 32.6% of complete specimen of the drill type, the

remaining ones are distal, medial, or other types, which are clear remains of broken pieces of drills.

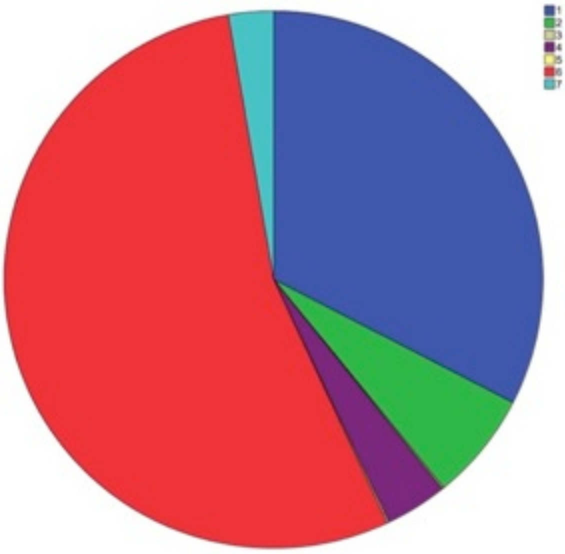


Fig. 8.171:State analysis of tapered cylindrical drills

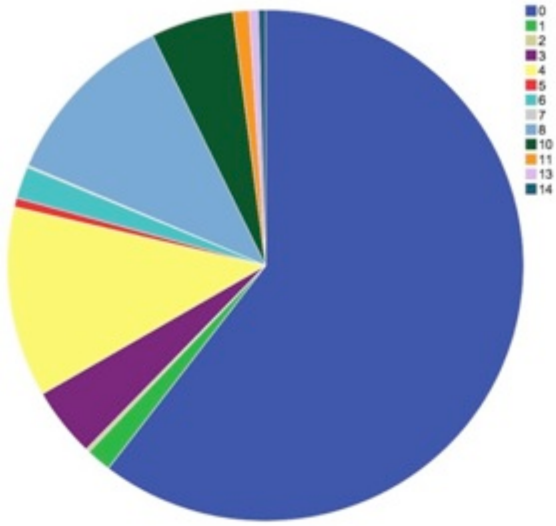


Fig. 8.172: Tip profile analysis of tapered cylindrical drills

Figure 8.172 shows the analyses for the tip profile of tapered drills and non-availability of tips are also taken into account : an overwhelming 60.4% have broken tips or no tips, again a clear indicator of industrial residue, as large number of drills were discarded after they were utilised and broke down during drilling process. This is followed by other tip varieties like convex ground (12.1%), dimpled (11.4%), nippled (5.2%), truncated ground (4.4%), flat (2%), chipped flat (1.6%) and dimple nippled (1%). The drills surface analysis indicates an overwhelming 94.3% of the drills have a ground grounded surface, a clear indication of continuous usage of drilling mechanism. This is followed by ground facetted (4.8%), chipped and ground (facetted) (0.7%) and chipped (0.2%).

The maximum length of the tapered drills (fig. 8.173) varies from 4.66 to 28.36 mm, with a mean length of 12.1 mm and a standard deviation of 2.92. A majority of the drills falls between 8 and 15 mm, while drills with length above 20 mm are rare in this category. As a majority of tapered drills is without tips, the

maximum length analysis was also carried out for the complete ones. The analysis could be made for 289 drills (fig. 8.174), which have a clear tip, and it indicates that the length varies from 7.05 to 26.25 mm with a mean length of 12.56 mm and a standard deviation of 3.123. Here too, a majority of the drills have a length between 8 and 16 mm.

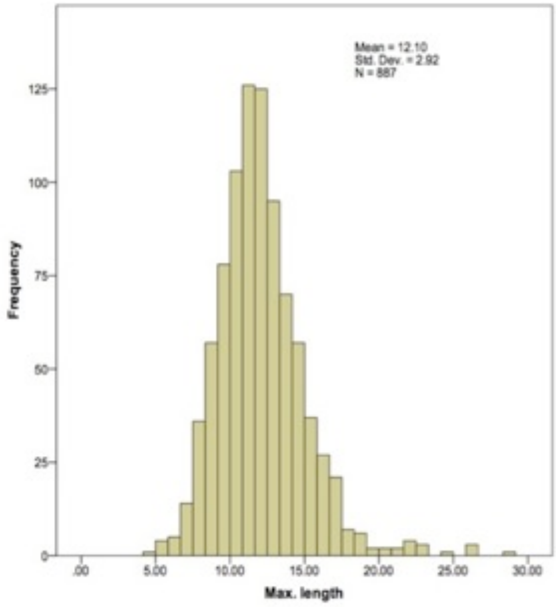


Fig. 8.173: Histogram of maximum length of all drills of tapered variety

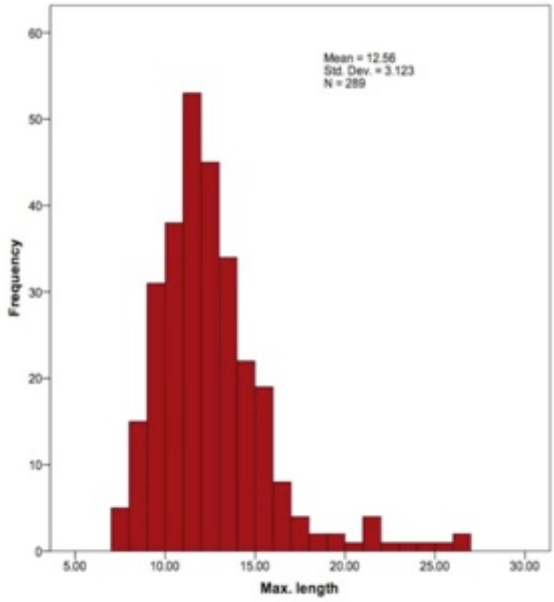


Fig. 8.174: Histogram of maximum length of complete drills of tapered variety

The next analysis taken up for tapered cylindrical drills was average thickness, which varies from 1.68 to 5.325 mm, with a mean width of 2.899 mm and a standard deviation of 0.432. A majority of the drills have a width between 2.5 to 4 mm and widths above 4 mm are rare. The bit length analysis (fig. 8.175) for the available 314 drills shows that the bit length varies from 2.44 to 17.16 mm, with a mean length of 5.88 mm and a standard deviation of 2.2. A majority of the drills have a bit length of 2.5 to 10 mm and those having it above 10 mm are very less. The base length, available for 755 drills, (fig. 8.176) measures 0.31 to 18.77 mm, with a mean of 7.11 mm and a standard deviation of 1.80.

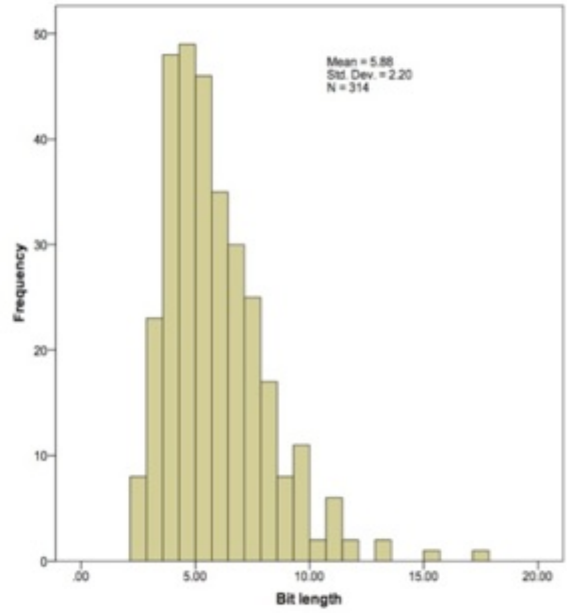


Fig. 8.175: Histogram of bit length of tapered variety

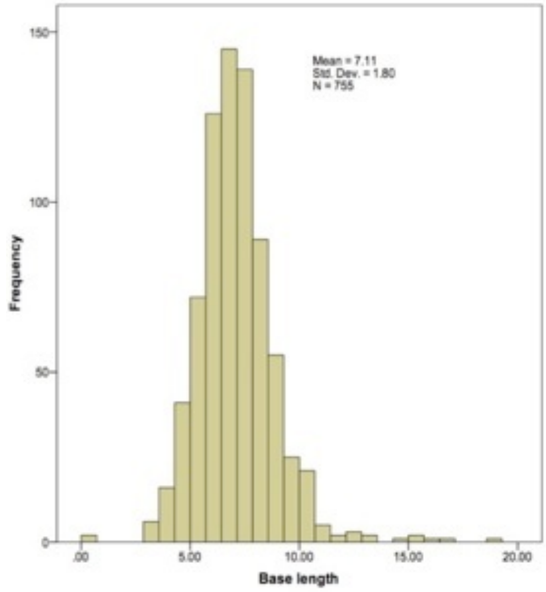


Fig. 8.176: Histogram of base length of tapered variety

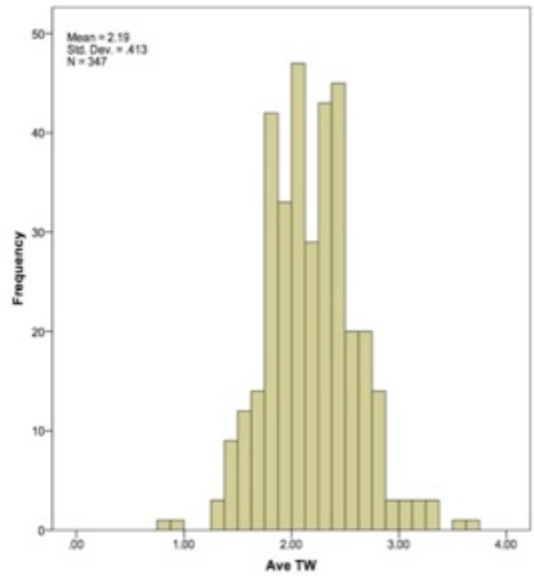


Fig. 8.177: Histogram of tip width of tapered variety

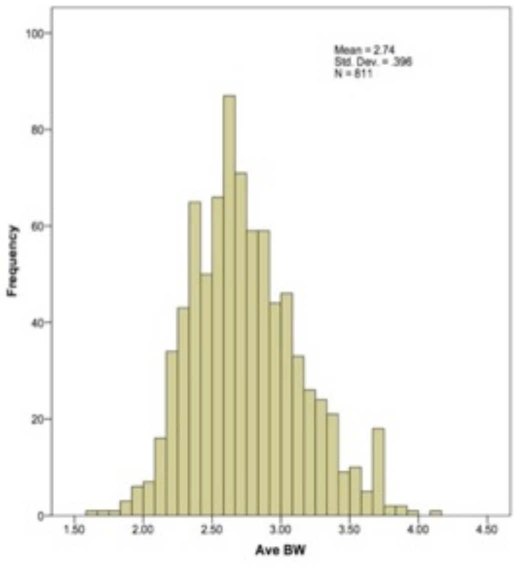


Fig. 8.178: Histogram of base width of tapered variety

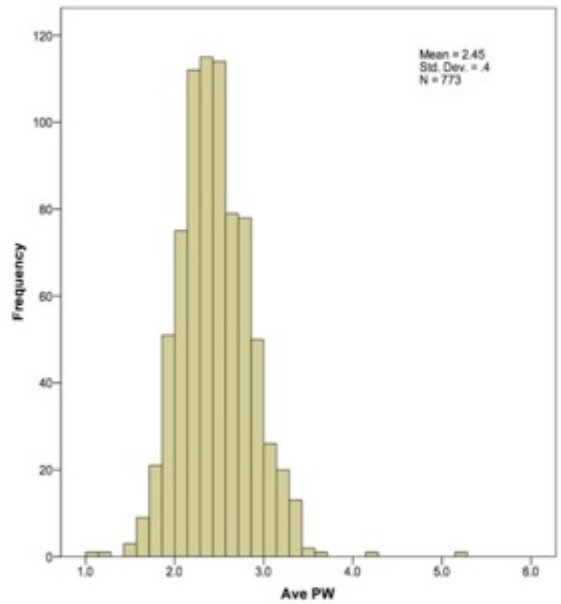


Fig. 8.179: Histogram of proximal width of tapered variety

The tip width, available for 347 drills (fig. 8.177), varies from 0.79 to 3.66 mm, with a mean of 2.19 mm and a standard deviation of 0.413. While tip width in a majority of the drills range between 2 and 3 mm, the tip widths beyond this are very less. In case of 811 drills (fig. 8.178), the base width varies from 1.63 to 4.15 mm, with a mean of 2.74 mm and a standard deviation of 0.396 while the proximal width for 773 drills (fig. 8.179) ranges between 1.12 and 5.245 mm, with a mean of 2.45 mm and a standard deviation of 0.4.

8.4.10.3 Constricted cylindrical drills

The constricted cylindrical drills constitute the third dominant drill type which represents 19.4% of the collection. The sub-variants out these are constricted cylindrical without base and ground (14.2%); constricted cylindrical with base (4.9%); and constricted cylindrical, ground faceted (0.3%). Out of the total 307 drills of this variety, the ones with ground surface and without base dominates with 73.3% which is followed by the ones with base and ground surface (25.4%) and the ones that are ground facetted (1.3%).

In respect of the state of drills of constricted cylindrical variety (fig. 8.180) an overwhelming 70.4% are represented by distal portion only, followed by

complete ones (20.5%), proximal-medial and medial (3.6% each), distal-medial (2%). The drill surface analysis (fig. 8.181) shows that 98.4% of the drills are ground grounded (not facetted), followed by ground facetted (1.3%) and chipped and ground (facetted) (0.2%). The tip profile analysis (fig. 8.182) of this variety revealed interesting insights. An overwhelming 88.2% of the drills have a dimpled tip, which is particularly dominating.

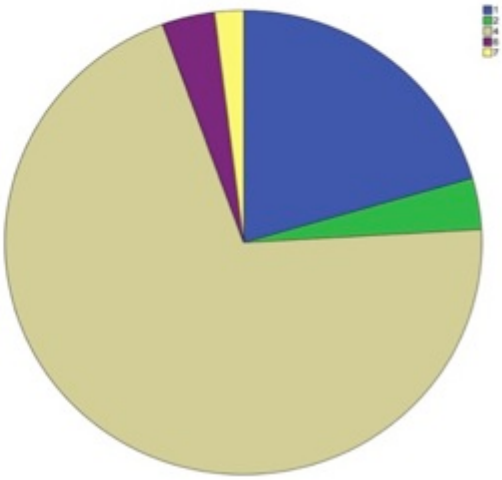


Fig. 8.180: Histogram of state of constricted cylindrical variety

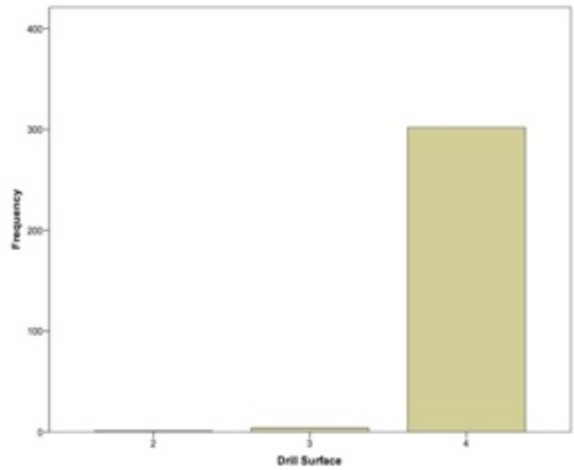
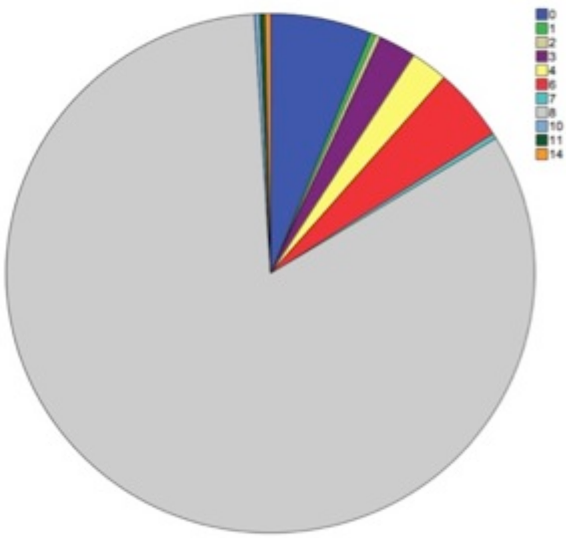


Fig. 8.181: Histogram of drill surface of constricted cylindrical variety

This is followed by flat (4.9%), truncated ground & convex ground (2.4% each), and 0.3% each of other varieties like chipped flat, chipped convex, flat bevelled, nippled, nipple-dimpled, and facetted. The analysis of maximum length (fig. 8.183) of drills of this variety indicates that it varied from 3.34 to 30.89 mm with a mean of 11.27 mm and a standard deviation of 4.156. A majority of the drills have a maximum length between 8 and 20 mm. Out of the 307 drills of this variety, only 63 are complete and their analysis for maximum length indicated (fig. 8.184) that it varied between 10.25 and 30.89 mm, with a mean of 15.97 mm and a standard deviation of 3.716. A majority of the complete drills of this variety have a length between 10 and 25 mm and drills with length above 25 mm are very rare. The tip profiles indicate that these drills could have been used only for a specific type of bead manufacturing.



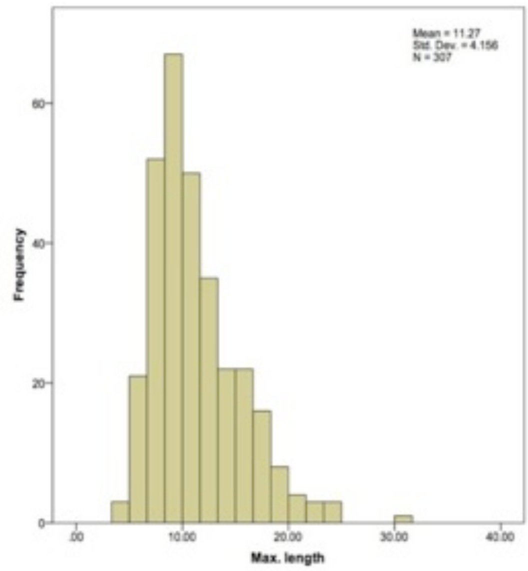


Fig. 8.182: Tip profile analysis of constricted cylindrical variety

Fig. 8.183: Histogram of maximum length of constricted cylindrical variety

The bit length could be found in only 76 drills and the analysis indicate that it varied from 2.56 to 17.95 mm, with a mean of 9.78 mm and a standard deviation of 2.895. The base length analysis could be done with the available 75 drills showing the length varied from 4.02 to 12.94 mm, with a mean of 6.87 mm and a standard deviation of 1.704.

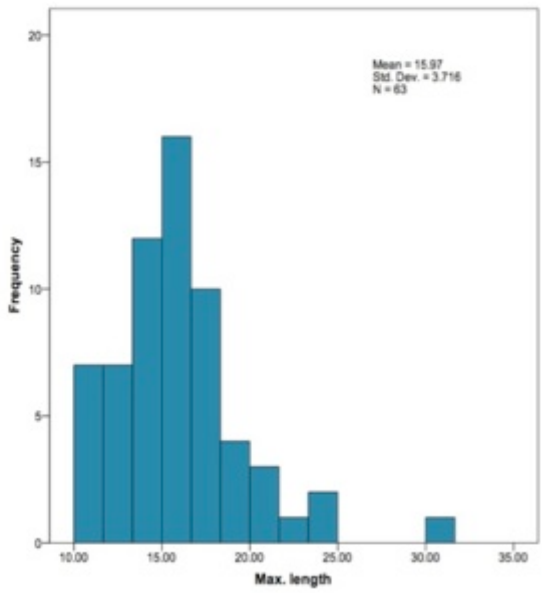


Fig. 8.184: Histogram of maximum length of complete drills

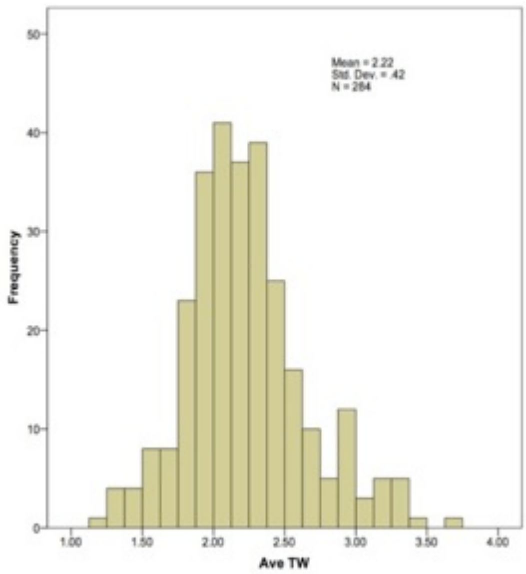


Fig. 8.185: Histogram of average tip width

The constricted cylindrical drills have a unique feature of thinning at the central portion of the bit length and hence it facilitated two measurements, one at the tip and another at the minimum width portion, each measurement consisting of two readings as mentioned elsewhere.

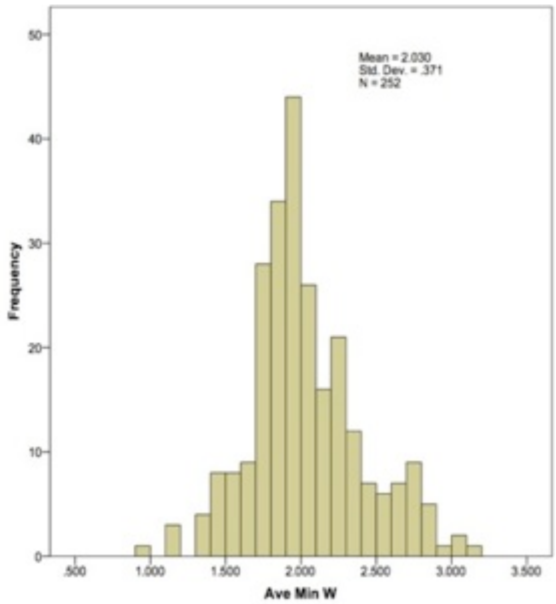


Fig. 8.186: Histogram of average minimum width

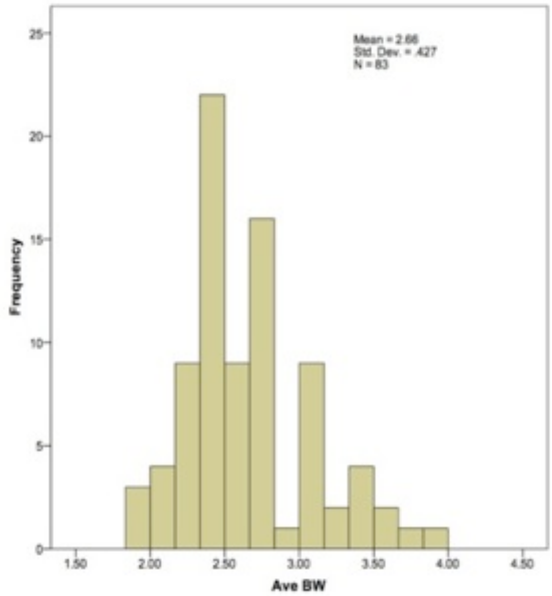


Fig. 8.187: Histogram of average base width

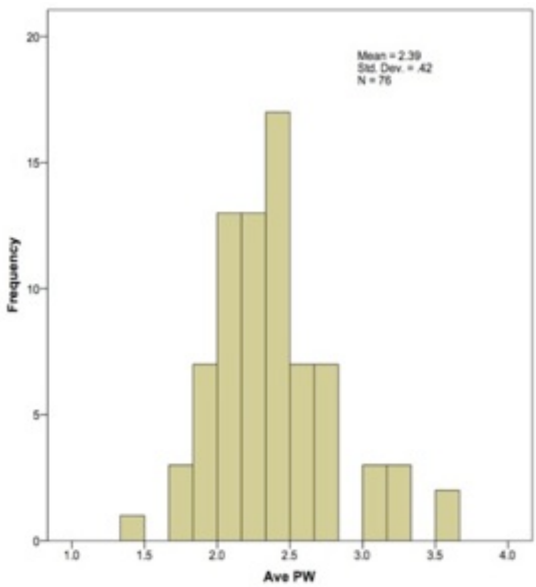


Fig. 8.188: Histogram of average proximal width

The average tip width (fig. 8.185) varies between 1.21 and 3.67 mm, with a mean of 2.22 mm and a standard deviation of 0.42. A majority of the drills have a tip width ranging between 1.5 and 3.0 mm; minimum width (fig. 8.186) varies from 0.99 to 3.155 mm, with a mean of 2.03 mm and a standard deviation of 0.371.

The base width analysis (fig. 8.187) in case of 83 drills varies from 1.84 to 3.94 mm, with a mean of 2.66 mm and a standard deviation of 0.427. Similarly, the proximal width (fig. 8.188) of 76 drills varies from 1.445 to 3.64 mm, with a mean of 2.39 mm and a standard deviation of 0.42.

8.4.10.4 Other drill types

The statistical analysis for the other drill types like the re-used, re-sized and pointed drills is not carried out as very less dataset is available. A total of 26 drills falling in re-used drill type and another 7 drills in the re-sized category are recorded. Only one example of pointed drill type is encountered.

8.4.11 Observations on the surface modifications of drills due to its usage

The drills were also subjected to microscopic analysis with the aid of a Dinolite USB Microscope for understanding various surface morphological variations due to their usage. The different portions of the tips like shaft, drill portion, tip, etc., were examined. Furthermore, microscopic examination was also conducted on drills in various stages of manufacture.

The analysis of drill roughouts indicates that chips were removed along their longer axis (fig. 8.189 a-b) and that they were then ground-facetted longitudinally. This also tallies well with the description given by Kenoyer and Vidale (1992) on the analysis of drills from Harappa. The evidence for creating a facetted side is clearly found on the surface of the drills in the form of striations due to various angles of grinding on a harder surface (fig. 8.189 c-e).

These striations do not follow any regular pattern and this indicates a grinding pattern as per the necessity to meet the requirements of a facetted drill blank. The presence of a stone with negative grooves from Dholavira (fig. 8.190) also suggests its usage for grinding drills, most probably of ernestite.

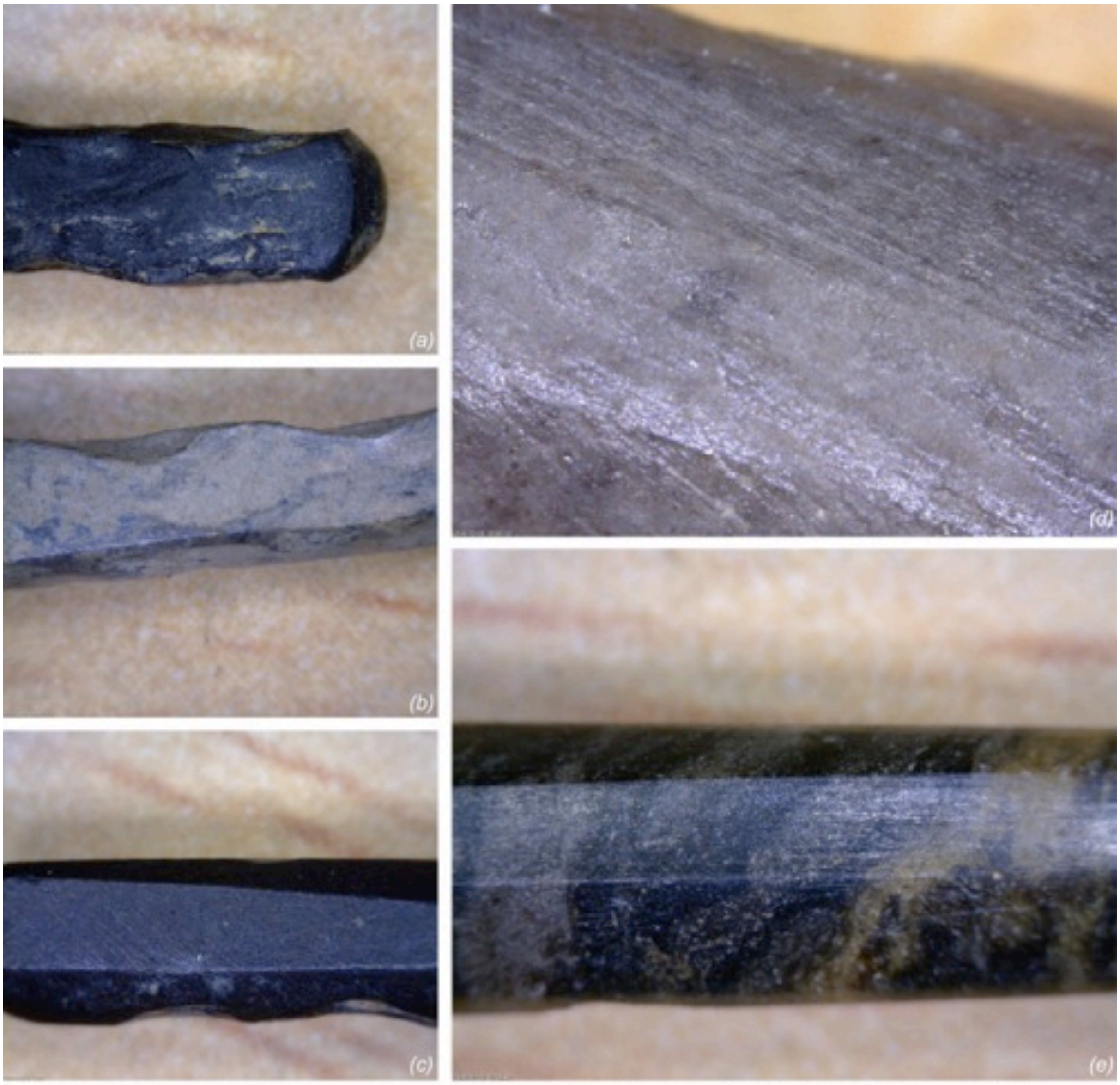


Fig. 8.189: Details of roughouts of drill bits



Fig. 8.190: Stone polishers for drill bits

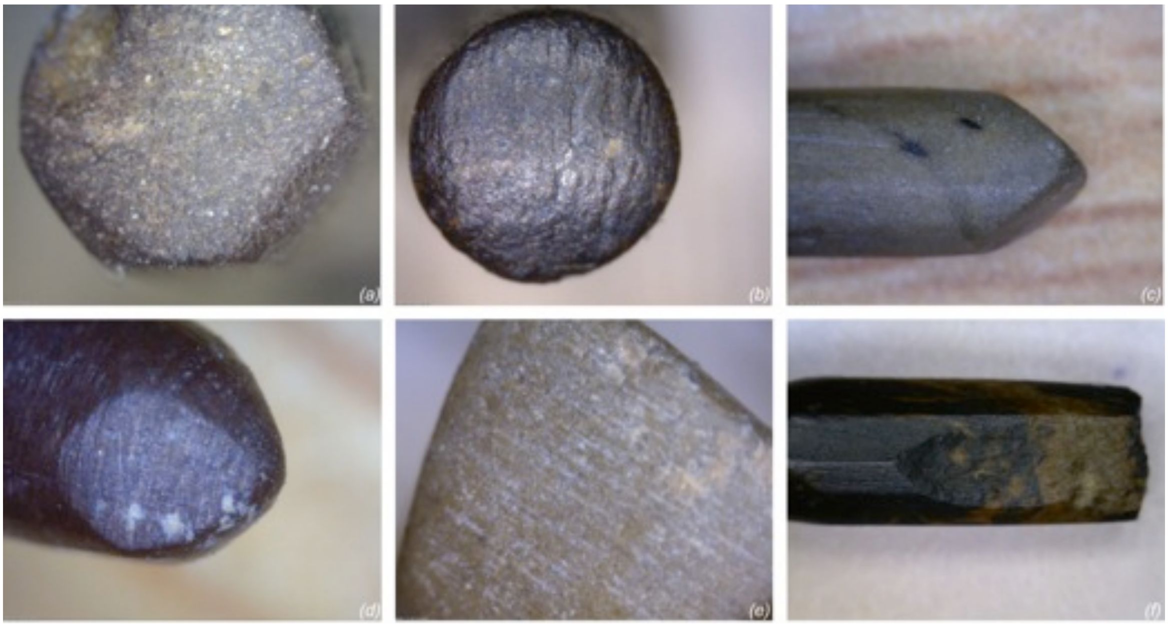


Fig. 8.191: Various profiles of tip surface of drill bits

The analysis of drills from Dholavira also helps in understanding the nature of unworked tip, which is a chipped-flat edge (fig. 8.191 a), with a raised edge (fig. 8.191 b), with a facetted edge having triangular cross-section (fig. 8.191 c) and a pointed tip with prismatic cross-section (fig. 8.191 d). That the tip of drills was grounded and fashioned to have a desired shape (fig. 8.191 e) is clearly understood through the microscopic analyses, which could not have been observed through a naked eye.

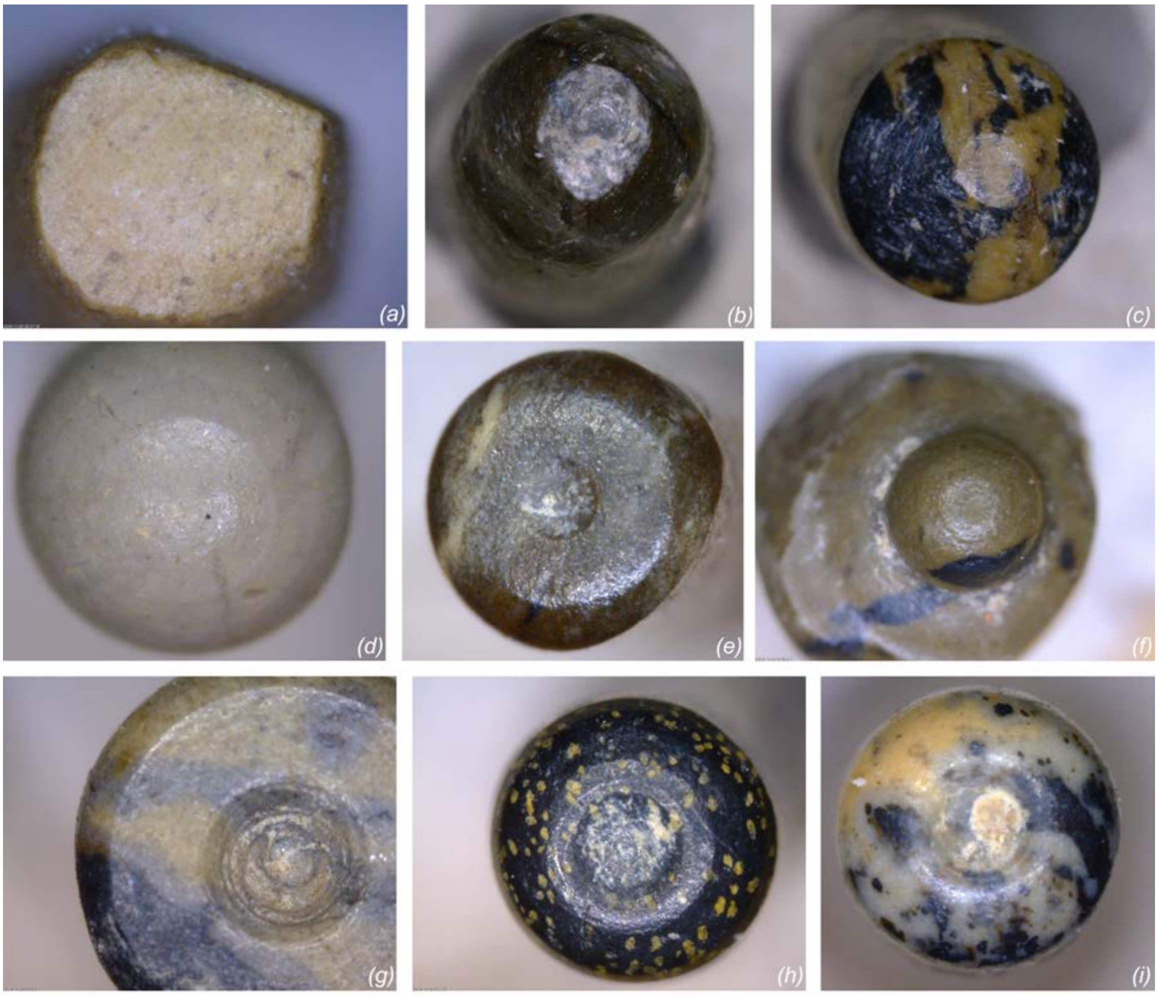


Fig. 8.192: Various stages of modification of tip of drills

The shaft of the drill might have been fashioned with a facetted cross-section in order to have a clear grip with the hafting tool. Some of the drill shafts also display deliberate chipping on at least two facets (fig. 8.191 f). The rough edges thus created could have facilitated a firm grip with the hafting tool in order to have a smooth drilling of beads. The drill tips underwent a series of surface modifications due to the intensive heat and grinding during the course of drilling holes in the bead. The surface of the drills also underwent wear and tear during the course of surface modifications, some of which could be seen clearly under a microscope. However, the order in the formation of these different patterns is yet to be understood in the absence of a detailed experimental analysis of ernestite drill manufacturing as well as drilling the agate beads.


Fig. 8.192a: Examples of breakage pattern on drill surfaces

This is partially because ernestite raw materials are rare from archaeological record and their provenance is yet to be determined. The various surface modifications of the tip that have been noticed and documented are flat, truncated ground, convex ground, nippled and dimpled (fig. 8.192 a-f). From the analysis of drill tips, it is also surmised that the dimpled tip could be the final stage of a continuous usage of drill before it is broken / snapped (fig. 8.192 g-i).

The drill record from Dholavira presents several examples of breakage at the tip point when the dimpled stage is reached (fig. 8.192a a-c). Further, the microscopic analysis also helped in understanding the imprints of internal dynamics from rotary motion of drills inside the bead holes in the form of deep striations, both clockwise and anti-clockwise tallying with the similar movement of drills (fig. 8.192a d-f). The breakage of spalls starting from the tip portion and proceeding in a radial pattern along the length of drill indicates the event while it is in use in a rotary motion (fig. 8.192a g). The evidence of breakage at the

central portion of drills indicates a sudden snap, caused again by the rotary motion of the drills, the snap being due to the intense pressure on the drills, which was stuck inside the bead holes along with byproducts of drilling and abrasives (fig. 8.192a h-j).

8.4.12 Conclusion

An attempt was made for the analysis of the drills of Dholavira in terms of statistics, typology and surface morphological changes due to the drilling mechanism. The methodology evolved by Kenoyer has been adopted here for the description of morphology of the drills, classification and coding, taking various measurements. In total 1603 drills were recorded and documented, which include 12 of chert, 2 vesuvianite, 1 agate and 1588 ernestite. An overwhelming preference for ernestite drills is obvious. The collection with the National Museum could not be taken up for analysis. The spatio-temporal analysis indicate that the bead manufacturing industry using ernestite drills was dominant during stages IV and V in the middle town locality. The middle town at Dholavira is a clear manufacturing hub of beads of various kinds.

The broad drill types noticed are cylindrical drills, tapered cylindrical, constricted cylindrical, re-used, re-sized and pointed drills. Only one specimen of pointed drill type is noticed in the collection. Chert drills are also a very few in number, hence the findings not repeated here. The break-up of the ernestite drill types is : tapered cylindrical 55.9%; cylindrical 22.5%; constricted cylindrical 19.4%; re-used 1.6%; re-sized 0.4%; pointed 0.1%. Of them 39.4% are complete drills, while the remaining 59.6% are broken and incomplete. The larger percentage of broken and incomplete drills is a clear indication of industrial waste.

Of the drills 40.2% do not have tips, they are either broken or partially broken, and the dimple tip variety dominates which has a presence of 23.6%, followed by convex ground tip (12.4%), truncated ground tip (5.6%), nippled tip (5.8%) and chipped flat (4.5%). The other types such as chipped convex, convex

faceted, flat bevelled, dimple bevelled, dimple-nipple and faceted are in a very smaller percentage. The larger percentage of broken tips as well as dimple tips clearly shows that 63.8% of the drills have been extensively used and might have been discarded when rendered inoperative. The maximum length of the drills varies from 3.34 to 45.11 mm, while the length of complete ones varies from 6.07 to 45.11 mm. Out of the 1588 drills, 625 drills are complete. The width of the drills varies from 1.245 mm to 6.885 mm with a mean of 2.861 mm.

Bit lengths in case of 656 drills are complete and ranges from 2.44 mm to 45.11 mm, with a mean of 8.43 mm. The tapered cylindrical drills are better represented with bit lengths followed by cylindrical and constricted cylindrical ones. The base length could be noticed in 873 cases ranging from 0.31 mm to 18.77 mm, with a mean of 7.03 mm. Evidence of a clear tip could be noticed in the case of 940 drills with the tip width varying from 0.79 mm to 5.37 mm, with a mean of 2.4 mm. Evidence for the presence of minimum width is noticed in the case of 256 drills and the width varies from 0.99 to 3.155 mm, with a mean of 2.033 mm. The base widths of drills are observed in 959 cases and it varies from 1.63 mm to 4.15 mm, with a mean of 2.74 mm. 1132 drills have proximal ends and their widths vary from 0.975 mm to 5.245 mm, with a mean of 2.48 mm.

The statistical analysis was also carried on the drills as per the types. The **cylindrical drills** constitute 22.5% of the total collection of ernestite beads. 68.7% of the cylindrical drills are complete ones. 53.6% of the drills are ground facetted, a clear indicator of extensive working of the drills. 64.7% of the drills have a tip profile clearly indicating its extensive working, wherein 19.7% of the drills have broken tip. The maximum length of the cylindrical drills varies from 4.39 mm to 45.11 mm, while the mean length is 11.76 mm with a standard deviation of 4.571 mm. The analysis indicates that the average width falls between 1.245 and 6.885 mm, with a mean of 3.086 mm and a standard deviation of 0.552. The bit length varies between 2.84 and 45.11 mm, with a mean of 11.62 mm. The tip ranges between 1.06 and 5.37 mm, with a mean of 2.82 mm. The base width varies from 2.29 to 3.39 mm, with a mean of 2.83 mm

and a standard deviation of 0.366 mm. The proximal width varies from 1.235 to 5.07 mm, with a mean of 2.66 mm. The spatio-temporal analysis indicate that the middle town has the most number of drills followed by castle, bailey and lower town.

The tapered cylindrical drills constitute 55.9% of the total drill types from Dholavira. The tapered cylindrical drills with base is represented by 71.3%, those without base are represented by 28.7%. The spatio-temporal analysis of tapered cylindrical drills again indicate the majority of drills during mature Harappan period, represented by Stages IV and V, and the middle town has most number of drills. A majority of 54.6% of the drills of this variety are proximal-medial, which is a clear indicator of industrial residue, as the tips were broken in a majority of the cases. The analysis indicates that an overwhelming 60.4% of the drills of this variety have no tips or broken tips. 94.3% of the drills have a ground grounded surface, which is a clear indication of continuous usage of drilling mechanism. The maximum length of the tapered drills varies from 4.66 to 28.36 mm, with a mean length of 12.1 mm while the complete ones have length varying from 7.05 to 26.25 mm, with a mean length of 12.56 mm. The average thickness varies from 1.68 to 5.325 mm, with a mean width of 2.899 mm. The bit length varies from 2.44 to 17.16 mm, with a mean length of 5.88 mm, while the base length varies from 0.31 to 18.77 mm, with a mean of 7.11 mm. The base width varies from 1.63 to 4.15 mm, with a mean of 2.74 mm and the proximal width varies between 1.12 and 5.245 mm, with a mean of 2.45 mm

The constricted cylindrical drills constitute 19.4% of the total collection of drills which have sub-variants like constricted cylindrical without base and ground (14.2%); constricted cylindrical with base (4.9%); and constricted cylindrical, ground faceted (0.3%). 73.3% of the collection of constricted cylindrical drills have no base while those with base constitute 25.4% of the collection. 70.4% of the drills of this variety preserve only the distal portion and also without base. 98.4% of the drills are ground grounded (not facetted) which is a clear indication of extensive use for drilling. An overwhelming 88.2% of the drills have a dimpled

tip, which is interesting as this tip profile dominates in this type of drills only. The maximum length of drills varied from 3.34 to 30.89 mm, with a mean of 11.27 mm. The bit length varied from 2.56 to 17.95 mm, with a mean of 9.78 mm while the base length varied from 4.02 to 12.94 mm, with a mean of 6.87 mm. The average tip width varied between 1.21 and 3.67 mm, with a mean of 2.22 mm. The minimum width varied from 0.99 to 3.155 mm, with a mean of 2.03 mm. The base width varied from 1.84 to 3.94 mm, with a mean of 2.66 mm while the proximal width varied from 1.445 to 3.64 mm, with a mean of 2.39 mm

The statistical studies along with the spatio-temporal studies have revealed the mastering of ernestite drilling technology during the mature Harappan phase. The presence of largest numbers of ernestite stone drills along with several examples of raw materials at Dholavira is a clear indication of its predominant role in bead manufacturing industry of the Harappans, which might have contributed even in the overseas trade. The study also indicates that the prominent working areas were complemented by the presence of bead workshops at Dholavira. The large collection of drills with evidence of re-used and re-sized ones indicates large-scale utilisation of ernestite material even to its smallest possible level due to its rarity and the fact that it is a remarkable drilling tool when compared to other stone drills. The morphological studies with the aid of a microscope were most revealing in understanding the various stages starting from the manufacture of drills to its usage and discard.

Thus, the statistical analysis on the drill of Dholavira has helped in understanding the various drill types, their sub-variants, tip types, bit and base lengths, tip, base and proximal widths. This has so far been the most comprehensive and exhaustive analysis of ernestite drill bits from any Harappan site and Dholavira has the distinction of yielding so far the largest collection from any excavation of Harappan sites.

8.5 Chert and Chalcedonic Blades and Modified Tool Elements

Dholavira has unearthed a huge lithic assemblage amounting to 6151(six thousand one hundred and fifty one, calculated upto the year 2002), perhaps the largest so far reported and studied from any Harappan sites in the subcontinent which include long and short blades of chert, chalcedony, jasper, agate, carnelian that were used by the Harappans of all seven stages for various purposes such as domestic, agricultural, art and crafting, including pottery-making, perforating of beads, etc, on a wide range of materials. The chert blades were held rightly to be one of the identity markers of the Indus Civilization and for all practical purposes, those still were essential items of the cultures. These blades are ribbon flakes and used as such as tools, frequently as sickle blades, besides being modified intentionally into a variety of tools or composite tools, such as, pen knife blade, borer, burin, percoir, point, drills, sickle, arrowhead, and what not for multipurpose use. In support of the use of sickle elements evidence may be cited from Mehrgarh period I, where one set of ten sickle blades was found hafted diagonally in a bitumen matrix to form a saw like cutting edge, perhaps used in harvesting crop and cutting grass for roofing, fodder, etc.

8.5.1 Background of research

It should be relevant to state that these chert blades or tools were not something, which was the creation of the Harappans. It has a long tradition going back to the Upper Palaeolithic Period when the basic technological innovation of producing parallel-sided blades from a carefully prepared core was developed. It continued all through the Chalcolithic and the Bronze Age Periods, and to the beginning of the Iron Age in certain pockets like Pirak in Kachi Plains. Among the Harappan traits, the craftsmanship of long chert blades is remarkable and so prolific that those "occur abundantly on all Harappan sites" (Wheeler 1968: 73), but never studied duly both typologically and technologically. Their use alongside copper and bronze tools found in Mohenjo-daro helped the excavators to term the culture as "Chalcolithic" (Marshall 1925-26: 75; Mackay 1928-29: 75). However, it took long decades by the scholars to understand the importance of these chert blades in the cultural milieu of the Harappans.

Alexander Cunningham was the first who reported these stone implements among an assemblage that included many other items like seals and pottery at Harappa in the year 1875. These discoveries however, remained undefined entity, as its both date and precise cultural context were unknown until the excavations at **Harappa** (D.R. Sahni 1920-21 and M.S. Vats 1933-34) and **Mohenjo-daro** (R.D. Banerjee 1921-22, 1922-23) were undertaken. M.S Vats (1921-22, 1933-34: 358-59) categorized the stone implements of **Harappa** in his report (Vats pub. 1940) as chert flakes, cores and burnisher. No stratigraphical detail had been provided at that time. Subsequently Mortimer Wheeler's excavation in 1946 at the "Defences and R-37" has stratigraphically revealed the location of lithic tools underlying the earliest Harappan stratum. (Wheeler 1947) Harappa was further excavated by G.F. Dales and Mark Kenoyar in 1988 (Excavation at Harappa in Pakistan Archaeology, No. 24: 129-130, 1989, Karachi) and Richard Meadow and J. Mark Kenoyar in 1992 and 1993 which yielded truncated blades, retouched blades, percoirs, gravers, flake scrapers and a variety of chert drills.

John Marshall (1925-26) and Ernest J.H. Mackay (1922-27) conducted large-scale excavations at Mohenjo-daro. The findings of the site from 1922-27 (Mackay: 58-59) include flint tools comprise of long flakes, cores; long saw retains one serrated edge, burnishers probably used on metals or lapidary's art. Unfortunately, during these excavations only the complete and outstanding samples of stone tools were recorded. Afterward, J.H.Mackay, in his excavation report "Further Excavations at Mohenjo-daro" (Mackay 1927-31:395-397) classified the flint tools as ribbon flakes, few of them were used as knives, beside cores, recognized to be used as burnishers later. In this collection, one flake, which probably used as polisher for wood deserves mention. Mackay too ignored the detailed analysis of lithic tools.

Between 1964-65 George F. Dales undertook digging at Mohenjo-daro near HR area and J.M. Kenoyer and Dales[1] provided six morphological types of the tools found from the excavations, which consist of true blades, crested blades, blade like flakes with or without cortex, cortex flakes, secondary flakes, blade cores. No flake, cores were found in this assortment.

At **Chanhu-daro,** Mackay reported only about chert ribbon flakes, saw-edged-blades, drills and chert cores later used as burnisher or polisher (Mackay 1935-1936: 230).

The famous site of **Mehrgarh** was excavated (1974-81) by the French Archaeological Mission in collaboration with the Department of Archaeology, Pakistan which revealed ten thousands flint implements of different types all through the seven cultural periods starting from the A ceramic Neolithic Period upto the Advanced Bronze Age i.e. from 7^{th} mill. B.C. to 3^{rd} mill. B. C. The artifacts consist of laurel leaf shaped arrowheads, chert blades having varied retouched working edges, sickle elements set into a bitumen found from the period I to VII and so on. The Bronze Age Period mainly revealed short narrow bladelet fragments and or geometric microliths often set at relatively steep angles. In the Chalcolithic Period sickle made of long blade fragments show denticulated working edge set at a very low angle in bitumen. Apart from blades, fluted, cylindrical, pyramidal cores, bladelets, borers, scrapers, burins, microlithic tools, mainly lunates, trapezes with concave back, triangles, flakes, and waste pieces were also encountered. From this report, a detailed examination of lithic tools with their precise functional aspects is established.

The chert blades, as an important cultural component also occur in the Zhob valley (Khan 1965: 38) of Baluchistan, Tharro Hills, Pandi Wahi, Jhukar, Ali Murad and the core excavated sites like Amri **(**Majumdar 1935, J.M. Casal 1964 and Flam1981), Kot Diji (F.A. Khan 1965 Flam 1981), Balakot (R.L. Raikes 1968 and Dales 1974), Allahdino (Fairservis 1979) in Baluchistan and all major and minor classical Harappan sites in the Greater Indus Region.

Out of these sites **Amri** and **Kot Diji** appears to be of the earliest date, in view of the occurrence of burinate tools on cores, saw edged blades and scrapers (Stuart Piggott, "Pre-historic India," 1950:121). Special attention was not paid on the techno-typological or morphological feature of these tools. According to S. N. Raghunath [2] these are not the products of the full-fledged "ribbon- flake-blade".

It is not out of perspective that away from the Harappan Empire, the contemporary sites also yielded comparable Indus-related objects, such as the excavated site of Altyn Depe in USSR, near the Caspian Sea, which provided the evidence of flint arrowheads (V.M. Masson 1988: 68) from the Bronze Age Period i.e. end of the 3rd mill .B.C. to the early 2nd mill. B. C. and Ra'sal-Jinz,[3] a coastal prehistoric site in Oman, excavated by the Joint Head Project from 1985 December and continued upto twelve field campaigns, also revealed Harappan materials in the periods II and III i.e.3rd quarter to last quarter of the 3rd mill. B. C. Among these materials, clusters of stone tools and associated debris deserve mention, which indicates that different types of manufacture were carried out in this site. Besides, the innate surroundings of the site provides the resources like chert, jasper, flint, etc., for making tools which have been exploited by the early settlers widely. No detailed study of these tools has been done yet. Therefore, the above-mentioned excavation reports do not incorporate the comprehensive examination of specialized types of chipped stones or chert blades, despite the fact that these tools had an important role in the society approximating to copper and bronze tools. Occasionally analogous tool type is noticed in the whispered materials.

Since the occurrences of these stone tools are very common in all the Harappan sites, even outside the sub-continent, we may trace its continuation in India also, predominantly in the Harappan perspective. At home, after partition, the Indian archaeologists particularly the Archaeological Survey of India and other organizations explored east of the Indus Region to locate Harappan sites in India and because of these explorations, a number of Harappan sites had come up. A cursory glance at the distribution of Harappan sites in India reveals the highest number of Harappan sites in Haryana(350), followed by Gujarat(230), Punjab(147), Uttar Pradesh(133), Rajasthan(75), Chandigarh(4), Himachal Pradesh(3), Delhi and Jammu one each. Further research work is still in progress. (Vasant Shinde and others, Occasional Paper 3, 2008: 77).

Among them, a number of sites have been excavated and reported. The foremost-excavated Harappan site in India is **Lothal** in Gujarat. Dr. S. R. Rao had prepared the meticulous study on the lithic objects of Lothalin his excavation

report Lothal 1955-62, published in 1979. The excavations yielded thousands of parallel-sided chert blades. The excavator (Rao 1955-62:558-560) categorized the blades into sixteen types and thirteen sub-types on the basis of secondary working of the tools. Type I shows razor-sharp working edge, IA retains primary flake-cut edges with trapezoidal and triangular edges, IB retains curve at the distal end, IC shows thin short flakes worked into blades, which retains small bulb and platform. Type II includes penknives and sickle blades, Type III shows close retouch on one or both the margins, Type IV is backed blade and deliberate grinding of both the margins retouch marks Type V, Type VI consists of minutely retouched blades with one grounded margin and another steeply retouched or polished margin. Type VII comprises of sub-triangular blades with retouched margins converging towards the distal end. Type VIII is serrated blade; Type IX has an oblique cut at the distal end producing a penknife end. Type XI has an oblique cut at the base producing a shoulder for hafting. Type XII is a notched blade, Type XIII is a blade-cum-engraver, and Type XIV has a truncated upper end resulting in a grueling point. Type XV is a blade on a narrow flake having a pronounced tang at the distal end. Type XVI is a blade scraper. Beside, asymmetrical flakes few are retouched, lunates of jasper, chalcedony, and short parallel-sided blades, sometimes represented by a solitary blade with crested ridge on the back are significant. Apart from the tools, conical fluted cores, small cores of jasper and chalcedony retain negative scars; cores showing discontinuous flake-scars indicating the failure to take out complete blades are also mentionable.

Excavations at **Surkotada** in Gujarat commenced by J .P. Joshi during 1971-72, yielded about four hundred chert objects (Joshi 1990: 252-266) comprising of parallel sided blades on ribbon flakes, with truncated ends and sharp unretouched margins, saw edged blades, sickle blades, pen-knife blades or razor, engravers, flakes, cores, beside, more than two hundred tiny stone tools or microliths manufactured on chalcedony, jasper, carnelian, milky quartz were also unearthed. Both pressure and percussion flaking techniques were adopted in taking out this ribbon flake blades.[4]

B.B. Lal and others, excavated the Harappan site at Kalibangan in Rajasthan, (Lal, Excavations at Kalibangan, The Early Harappans 1961-69, 2003: 223-229) revealed twenty-five microliths made on chalcedony, agate and jasper and twelve long chert blades manufactured on ribbon- flakes from the Early Harappan level. The microliths comprise of small blades, flakes, points, side scrapers, notched flakes, serrated blades and appear to be a hangover of the Late Stone Age (Madhu Bala , Excavations at Kalibangan, "The Early Harappans": 223). The chert blades consist of unretouched blade, serrated blade; backed blade and retouched blade. Apart from these sites, the excavation reports of **Kuntasi** (Vasant Shinde 1996:282**), Rojdi (**Y.M. Chitalwala 1989:158-159 in Gujarat, **Mitathal** (Suraj Bhan 1975 :59), **Farmana** (Vasant Shinde and others 2008: 97-100), **Girawad** (Shinde and others 2006-07 :77-132), **Madina** (Man Mohan Kumar and others 2007-08 :77-169) in Haryana provided little evidence of chert blades.

8.5.2 Typo-technology

The present site Dholavira has yielded maximum amount of long chert blades and microliths or short blades from all the seven stages, which include Pre-Harappan, Harappan and Late Harappan levels of the site. Among them, stages I and II were exposed in a limited area, only confined to the S-W corner of the Citadel. Stage III is overburdened by the subsequent stages IV, V and VI, from these three stages; maximum numbers of chert blades were encountered all over the site. After a thorough and careful study of thousands of lithic implements, these have been divided into six main groups:

a) Long retouched and unretouched blades including the tools modified into knife, burin, borer, percoir, point, arrowhead or arrow point and scraper.
b) Short blade components represented by bladelet, blade, point, arrowhead, scraper, microlithic drill, semi-geometric and geometric tools like lunate, trapeze, triangle.
c) Blade cores
d) Flakes
e) Burnisher and Polisher

f) Debitage



Fig. 8.193: Chert blades



Fig. 8.194: Denticulates, Cert



Fig. 8.195: Chert tool assemblage

In this total tool assemblage, the comprehensive term `Blade` is being used specially to justify the predominance of the blade type. Some specific techniques have been used for manufacturing special types of lithic blades. At Dholavira, both the indirect or direct percussion technique applied for manufacturing long and short blades, as revealed by the available specially prepared cores, waste flakes, etc. The thin and short blades with regular and parallel borders have been produced by pressure flaking technique. In every case, the removing of delicate flakes depend on the nature of raw material and needs of man, it may be long or short blades. The mass manufacture of blades has been made from single platform unidirectional blade core, single platform polyhedral blade core, opposed platform unidirectional blade core and prismatic blade core or pencil core. Thus, preparation of core is the principal procedure of blade manufacturing.

8.5.3 Group-wise classification of long blades

A. The typology of long blade mainly depends upon the nature of retouching and based on which unique types of blades of Dholavira have been categorized and put under different terminology.

1) Normally Retouched blade
2) Unretouched blade
3) Edge damaged blade
4) Notched blade
5) Sinuous blade
6) Denticulate blade
7) Constricted retouched or strangled blade
8) Backed blade
9) Crested ridge blade
10) Ground edge blade
11) Modified blade

Starting from nos. 1 to 10, these blades have been named according to the nature of retouching, but modified blades are those, which have been made out of regular long blades struck from the prepared core. Most of the modified blades were used as cutting or boring tools, sometimes these were snapped into smaller segments intentionally, few were used as blanks and others shaped into penknife blade, burin, borer, percoir, point, arrowhead, scraper by the people according to their requirement. The approximate percentage of normally retouched blades including the modified ones is 66%, unretouched blade 8%, edge damaged blade 5%, notched blade 6%, sinuous retouched blade 1% , denticulated blade 5%, constricted retouched or strangled blade1%, backed blade2%, crested ridge blade 3%, ground edge blade3%.. Usually these blades are thick, few are thin , averaging 51mm in length, 11.9 mm in width and 5.1 mm in thickness and sometimes achieving length greater than 123.6 mm, width 61.2 mm and thickness 42.1 mm. The most striking feature of such blades is the pair of parallel ridges down the length of the dorsal surface giving a trapezoidal cross section. The dominance of parallel ridges and standardizes in production indicate

that the shape was deliberately sought. In case of single ridge blade, the cross section is triangular. Both the features are available at Dholavira.

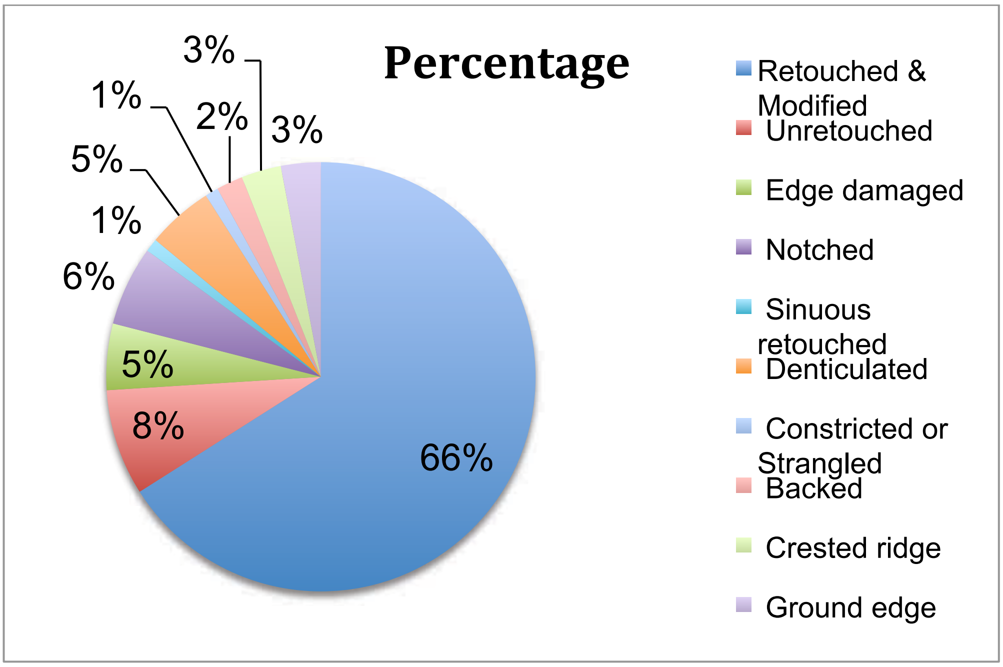


Fig. 8.196: Pie chart showing percentage of tool types



Fig. 8.197: Chalcedony tools

B. Approaching to the short blade assortment,bladelets occupy the prominent place. Two basic technologies, percussion and pressure techniques were employed for the production of **bladelets,** which were struck from the single platform unidirectional or multi directional fluted prismatic blade cores or pencil cores. It is often difficult to distinguish Between the blade and bladelet production. Bladelets sometimes appear with simple retouch and edge damage in various locations.

The technology of tiny **blade** tools involves mainly in the preparation of cores at the first stage. Here, usual percussion technique is used to transform any nodule or natural pebble into a prismatic shape. Same type of cores like blade-lets has been used. Striking platform is prepared at the end of the longer axis and pressure is given from the edge of the striking platform by using a pointed bone, antler or specially prepared wood. Thus, the smaller simple blades, prepared from blade cores, are generally short with little evidence of platform preparation. Specific tool types like knife, point, percoir, transverse arrowhead, or arrow point, scraper, drill prepared by giving a series of retouching along the borders or working edges of these short blades. Semi-geometric and geometric tools like lunate, trapeze, and triangle are infrequent in the excavated area, which were also manufactured by following the same techniques probably with hand support. Abrupt retouching and backing are almost absent in this category of tools. The **drills** were made from secondary flake blade by providing unifacial modification to a \`T\` shape by using inverse percussion technique or Cambay (Khambat) technique. This technique is useful for producing small objects.

C. BladeCores are most abundant artifacts found in the Harappan sites. However, in this very site the percentage of core is unusual. Only three types of blade cores for the long blades are found in the collection, i.e. single platform unidirectional blade core, single platform polyhedral blade core, opposed platform unidirectional blade core. The first two types of cores are composed of prepared blade cores which show striking platforms and multiple removals mainly from one direction and the third significant type is opposed platform unidirectional blade core where platforms are found in two

longitudinal directions. Prismatic cores and pencil cores (with a pointed tip) or fluted cores of chert, chalcedony, quartz, jasper, agate and carnelian were also used in manufacturing of short bladelets and blades.



Fig. 8.198: Blade cores (fluted core)

D. Flakes are those pieces that do not incorporate special morphological attributes but they may include a range of special technology, as found in the tubular scraper flake. Here, in this collection, retouched flake, edge-damaged flake, flake with crested ridge, scraper flake, core-trimming flake justify particular mention. Among these, the core-trimming flake needs explanation. When a long or short fluted core is not capable of yielding any more flakes, it becomes conical and needs a fresh preparation by giving medium blow, which removed disc like thick flakes from the core. This is called core-trimming flake. It's under surface is the primary flake surface, while the upper surface is conical or convex with a battered keel and produce a triangular or Plano-convex section.

E. **I**n the collection of burnisher and polisher at Dholavira, chert burnisher with ripple flaking on the borders, rock crystal burnisher and core-trimming polisher deserve special attention. Sometimes, the cores after regular utilize, used as burnisher or polisher, as evidenced from most of the Harappan sites.

F. The next important category is debitage. Rejuvenated cores, waste flakes and other chips or nodules exhausted due to maximum use come under this group. At Dholavira, a minimum amount of debitage has come across. Here,

the finished and unfinished deluxe tools outnumber the debitage, flake and core.



Fig. : 8.199: Cores



Fig. 8.200: Blade cores (fluted core)

8.5.4 Sources of raw material

While studying these artifacts, Randall Law from Wisconsin-Madison University, USA, who worked at Harappa in Pakistan, helped in identifying the raw materials used in manufacturing the tools. The outcome of the study is that all the aforementioned tools were prepared from a selected category of raw material i.e. cryptocrystalline silicate, referred to as chert, with a varying colour,

quality and shading, out of which these tools were manufactured .Most of the blades were made from fine grained, good quality grey chert. Within this category, about 50% are mottled chert; their colour varies from light to dark grey, sometimes whitish. Buff chert was also in use. Banded cherts, frequently with fish scale like band having different shades like grey and brown, buff and brown, brown, black and white, grey, brown and yellow, purple and brown, light and dark brown are well identified.

It has been calculated that at least eight (8) varieties of raw materials were used in the total tool compilation including the short blades, viz. fine grained chert of different categories, (such as, mottled, unmottled, opaque, translucent, tanned, banded, etc.); white chalcedony, agate, jasper, carnelian, quartz, hematite sandstone and hard lime stone. It is to be noted that, there was no shortage of local raw materials, chert occurs in the agate-bearing conglomerate of the north-western corner of the Little Rann of Kutch, but exploitation is difficult due to inaccessibility of the area, besides, the quality was feeble for tool production. Inadequate number of blade tools made on local inferior quality black and brown chert confirms this fact. Hence, the Kachch Harappans had to opt for best quality substance in the Sind region.

It has been studied that, about 99% long blades were made out of fine quality chert, mostly banded which might be transported from the limestone hills at Rohri and Sukkur or Sakhar of Sind (personal discussion, Randall Law). The deluxe tools were prepared on the unique (fish scale) banded chert. In comparision to the finished tools, the amount of flake, core, waste flake and raw material is trifling. Now the question is whether the raw materials in terms of nodules, chunks and cores for manufacturing tools or the finished tools brought from this region in turn of other items like beads, etc. As no “factory site” is evidenced from Dholavira as well as from the nearby areas. The answer may likely be that, the chert nodules or cores were first worked at the factory sites of the Rohri Hill area or the neighbouring region, then they were imported or transported by rivers or land routes to the Harappan cities where people manufactured tools as per their requirement.



Fig. 8.201: Map showing raw material sources

In this context the evidence of flint knapping "factory" at Rohri may be cited which was well known for tool production and transportation of the same to the smaller Harappan sites (Mughal 1970:42). Therefore, the negligible amount of flake, core, and debitage recovered from Dholavira predict this fact. The other

raw materials like white chalcedony, agate, jasper, carnelian, quartz, hematite sandstone and hard limestone are well obtainable in Gujarat, Maharashtra and Rajasthan.

Thus, at a quick look, the lithic blade production of Dholavira was probably initiated with diminutive quantity of lithic implements in the shape of long and small blades of silicious materials, as evidenced from the excavations. Later, during the Classical Harappan Period, the intensification of which reached to its summit i.e. the .manifestation of huge well- finished, modified, long blade manufacturing, which has got similarity with the tools of Rohri area in terms of typo-technology. Thus, the long blades attained the lineage of the earlier technology with some improved alterations and modifications. Keeping it in mind, perhaps Soundara Rajan has correctly opined that the ancestry of Harappan stone tool assemblage is naturally be looked for in earlier Sukkur-Rohri stone cultures which have been called as Proto-Neolithic by Paterson.[5]

The analysis of the tools leads to the conclusion that these are the most significant archaeological finds in the Harappan time because the same connected chronologically the Middle Stone Age with the Bronze Age and the technique of production is more or less same with modest alterations and modifications. Apart from long blades, a number of deliberately snapped small segments of blades also found which retain tang either on proximal end or distal end, probably used as regular blades for various purposes, as evidenced from their retouched working edges. Depending on the nature of retouching, these blades have been classified and place under special terms like denticulate blade, notched blade, sinuous blade, constricted retouched or strangled blade, backed blade, crested ridge blade, ground edge blade, normally steep retouched blade few having bow shapes, moreover modified blades, unretouched blades and edge damaged blades also came across during excavations. The edge of the latter blades was damaged either intentionally or accidentally to make use of. Thus, the above-mentioned blades recovered from the excavations, must have flexible use for different purposes, such as, the denticulate blades with saw like working edges could be used for weaving wool, comb-out pottery, the notched blades may be used for creating design on shell objects, constricted retouched or

strangled blade, could be used on wood, normally retouched and crested ridge blades may be used for peeling of wood, vegetable, meat and so on, bow shaped retouched blades retain one grounded and smooth lateral border probably for holding purposes, another steeply retouched curved lateral edge for removing extra soil from pottery and also for smoothening the pot, edge damaged blades for producing designs on softer materials, and so on.

Besides, the modified tools like percoir, borer, burin or engraver are utilized for making hole in the wood or etching the outlines of script on seals and etching on the shell objects. In this context the utility of chert drills at Chanhu-daro may be cited which have been used on disc shaped irregular carnelian beads. The bead is bored from both the sides that leaves a hole in the middle and depicts rough surface, to be smoothened down later (Mackay 1935-36:210-211). Same type of tools made on parallel-sided blades are found from Surkotada excavations and identified as engravers and borers, (Joshi 1971-72: 259) because these have a very short, retouched tip at the distal end, which is obtained by notching. The working ends of these tools are so blunted and broad that could not be used for boring delicate beads rather than rough blanks. These types of modified blades- cum borers, having short tip point on both the distal and proximal ends are also discovered from Dholavira. Hence, these versatile blades are considered as the key artifacts in spite of having common use of metals.

8.6 Copper and Lead Objects

8.6.1 Copper Objects

Like other Harappan settlements, excavations at Dholavira have also yielded a good number of specialized copper and bronze objects. Typologically they may be divided into five broad categories which included tools, weapons, personal ornaments, objects of domestic use and figures. Although it is difficult to make a hard and fast distinction of certain tools as objects like axe, spearhead etc could be used as weapons of both offensive and defensive purposes. As an industrial and trading community it seems that the Dholavira Harappans preferred to pay much attention to the improvement of tools required by the carpenters, stone workers, copper smiths and lapidaries, than the production of more advanced types of offensive and defensive weapons.

Other objects include personal ornaments mainly consisted of corrugated bangles (limited number), abundant number of rings both simple and coiled type of both small and medium size, a large number of beads, spacers beside a bronze animal figurine etc which give a wide impression about their adequate knowledge of the metal works especially the copper objects followed by gold, silver and lead. But, before going in detail a complete knowledge regarding the material findings of some of the important Pre-Mature Harappan and Harappan sites will be useful in understanding the introduction and gradual evolution of metallurgical activities of the Harappans with special reference to Dholavira.

Often it was believed that the birth of Harappan culture was due to the impact of the West Asian influence, but, the recent works in various Northwest sites have established the fact that these progresses are the product of an indigenous development of urban cultures from hunting- gathering and the Neolithic stages. For the greater Indus regions, the evidence from Mehrgarh and other early sites demonstrates that the metallurgical innovations of the Neolithic and Chalcolithic periods set the technological background for the metallurgical traditions of the Harappan stages.

It has been confirmed that the origin and development of copper metal technology occurred in combination with developments in other technologies.

During the 5th to 4th millennium B.C, changes were occurring simultaneously in metal production along with other changes took place in the things like ceramic, drilling in hard stone, beads, shell working etc. Such kind of transitions which happened in Mehrgarh were also witnessed in the highlands of Baluchistan, and other greater Indus regions like Nausharo, Balakot, Ghazi Shah, Rahman Dheri, Kalibangan etc. All these sites revealed that the use of copper prior to the Harappan phase along with changes in other technologies. Kenoyar believes that throughout southern and northern Baluchistan, Afghanistan and Rajasthan, the combined resources of metal ores and fuel were available to communities of sedentary agriculturists and semi nomadic pastoralists. Such communities were undoubtedly familiar with the properties of ores and how to extract the metal long before it became an important economic process.

Copper as an important cultural element occurs in all the Harappan sites .As told earlier that excavations at Dholavira have yielded a great variety of focused copper and bronze objects. After a careful and analytical study of all these objects tentatively the following variety of tools has been classified that were used by the inhabitants of Dholavira:

- Antimony rod
- Arrowheads with backwards projecting barbs:
- Bangle
- Blade
- Blade axe
- Chisels of both long and short variety
- Circular disc like object
- Fish hook and simple hook of both long and short variety
- Knife with a thin leaf shaped blade
- Nails or Bolts
- Point
- Razor
- Ring, both coiled and simple type
- Rod of different sizes

- Spearhead or Lance head of various sizes with a tang
- Spindle rod

Among all these objects, few items like chisel, arrowhead, rod etc. irrespective of their sizes have been encountered in plenty number, whereas the remaining ones are low to medium in strength. Selected pieces have been chosen as a representative type and most of them require adequate chemical treatment for Better understanding of their functional as well as behavioural aspects. The assemblage shows that they are very typical and has their parallels in Harappa, Mohenjodaro, Chanhudaro, Kalibangan, Lothal, Rangpur etc.



Fig. 8.202: Copper tools



Fig. 8.203: Copper tools

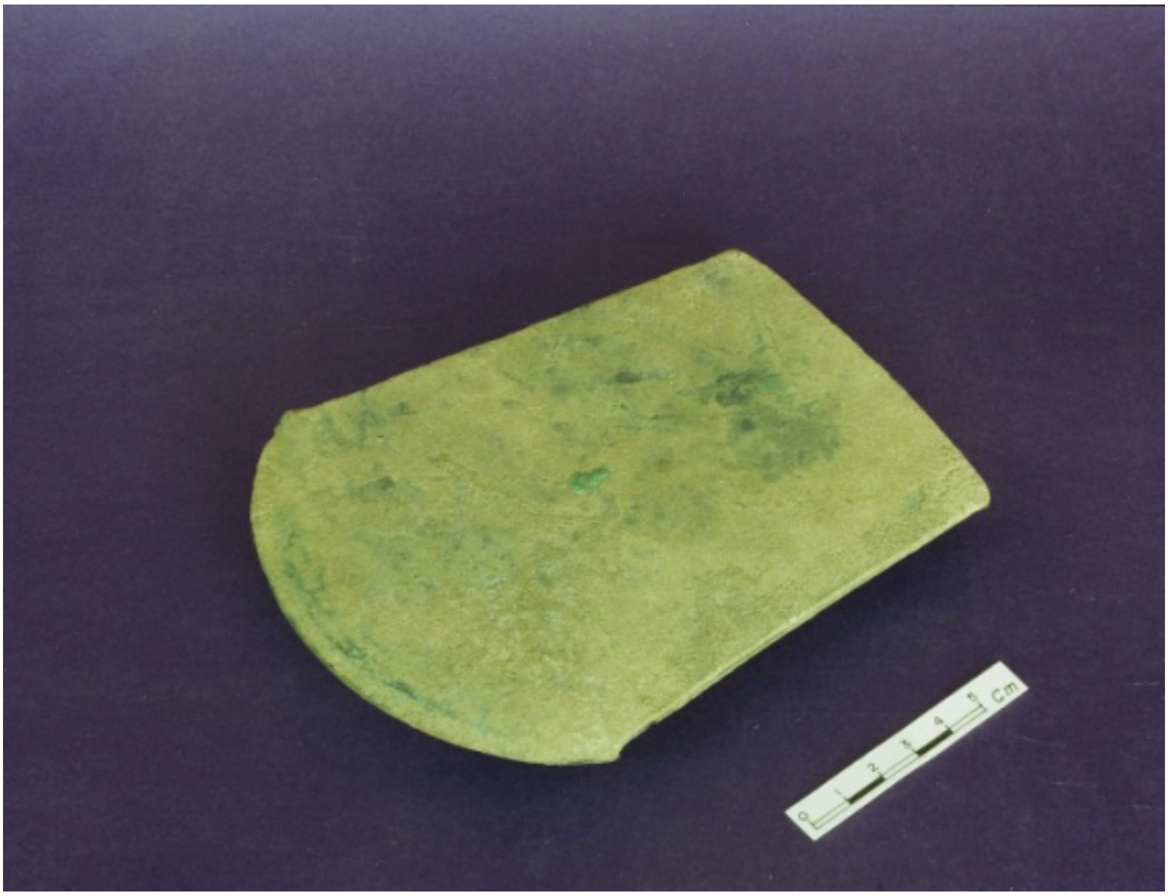


Fig. 8.204: Copper celt



Fig. 8.205: Copper crucible



Fig. 8.206: Copper tools (arrowheads, chisel, razor, etc)




Fig. 8.207 Copper animal figurine (left); Fig. 8.208: Copper cooking pan (right)




Fig. 8.209: Copper mirror (left); Fig. 9.210: Copper bangles (right)

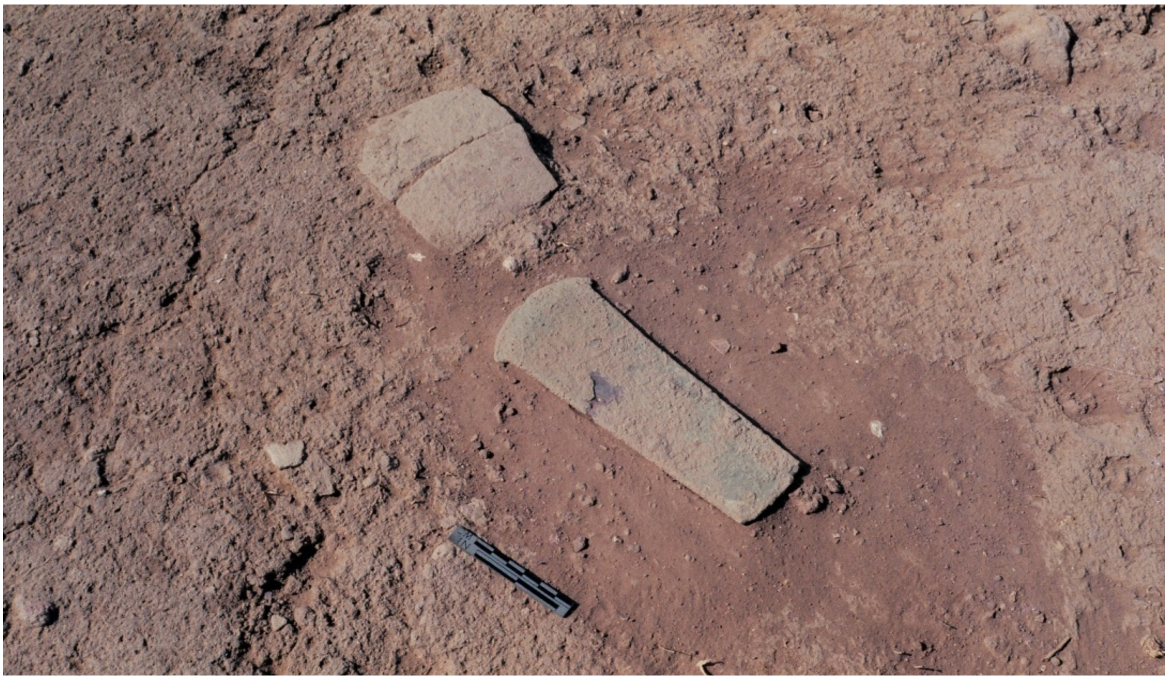


Fig. 8.211: Copper celt *in situ*



Fig. 8.212: Copper spearheads



Fig. 8.213: Copper spearheads



Fig. 8.214: Copper razor



Fig. 8.215: Copper chisels, needles



Fig. 8.216: Copper rods and needles



Fig. 8.217: Copper fishhooks

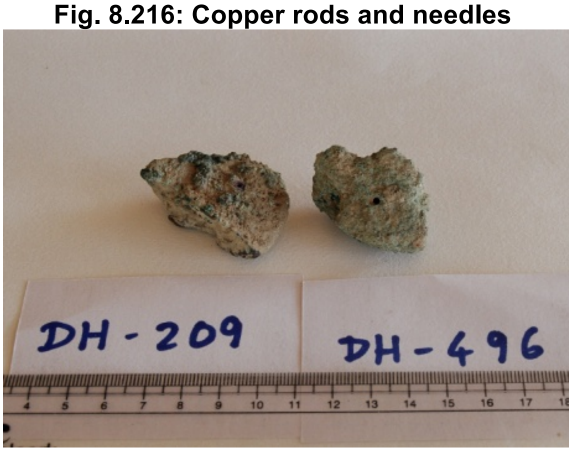


Fig. 8.218: Copper obejct for analysis

In course of study it has been found that blade axe, spearhead, knife, chisel and razor are the most prominent one. As far as the blade axe is concerned, the general slope of their cutting edge is found on the both sides and are of mainly two types long and narrow and short and broad, although the later one are more wide in its use. Their sizes are often varies from 3-5 cm.

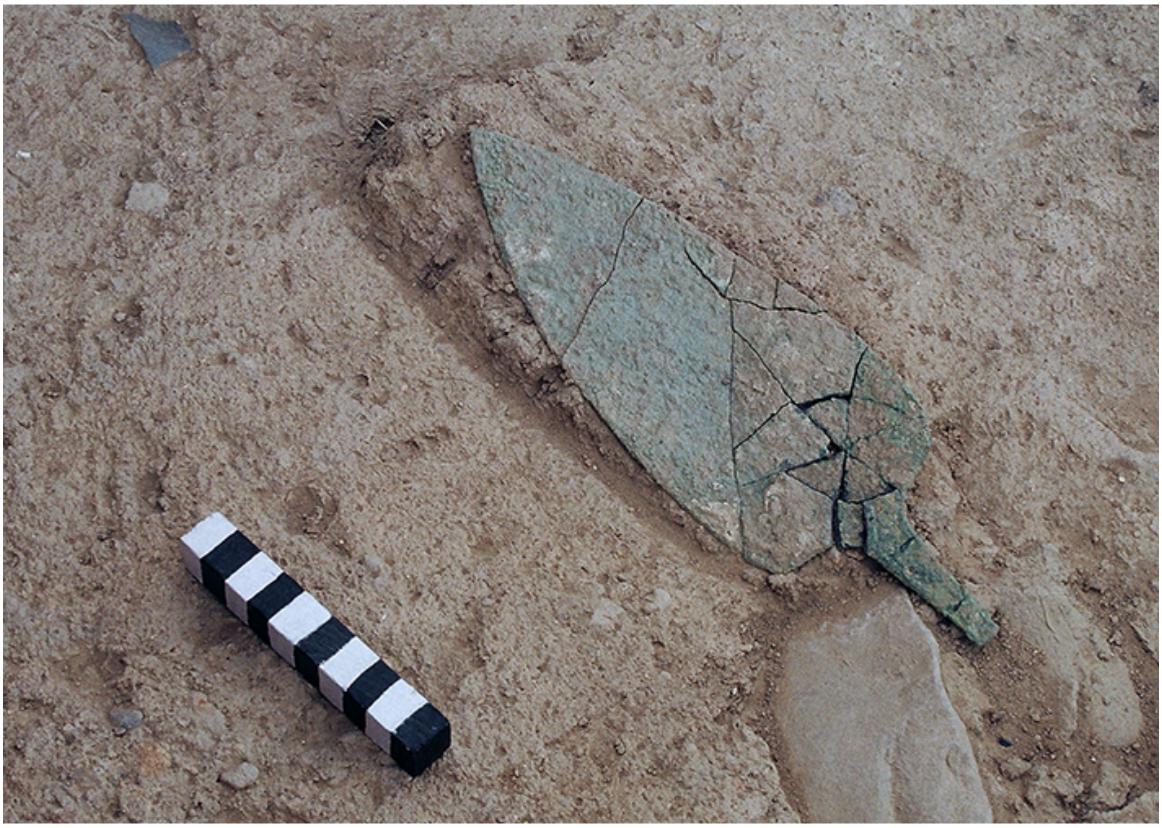


Fig. 8.219: Copper spearhead *in situ*



Fig. 8.220: Copper spearhead with holes for hafting



Fig. 8.221: Copper hammer(?)



Fig. 8.222: Copper chisels

Spearhead or lance head, an important tool that was made from the rod of metals where tangs are thicker than the body. Such kind of tools was perhaps taken into the use of cultivation, like scooping the earth, which requires a solid tang. All these spear heads are mainly leaf shaped, thin, and in some cases the shaft is more slender and elongated in nature, with a dwarf tang, somewhere the latter are found to have missing. They are of various sizes which vary from 19- 26 cm in length with a width of 7-9 cm occasionally. Most interestingly some of the tools

bear grass impression. Presently the section has few such pieces, but they represent a class of its own.



Fig. 8.223: Copper tools



Fig. 8.224: Copper tools



Fig. 8.225: Copper spearhead



Fig. 8.226: Copper ornaments

Razor, another important tool of the Dholavirans, has been classified into double bladed and single bladed sub type. Here blades are always thin in nature whereas the tangs are oval in section and not much thicker. Perhaps they were roughly cut out of sheet metal and the blades are subsequently spread by means of hammer before finally trimmed into shape. Their general length varies from 4.5-17 cm which is the longest one.

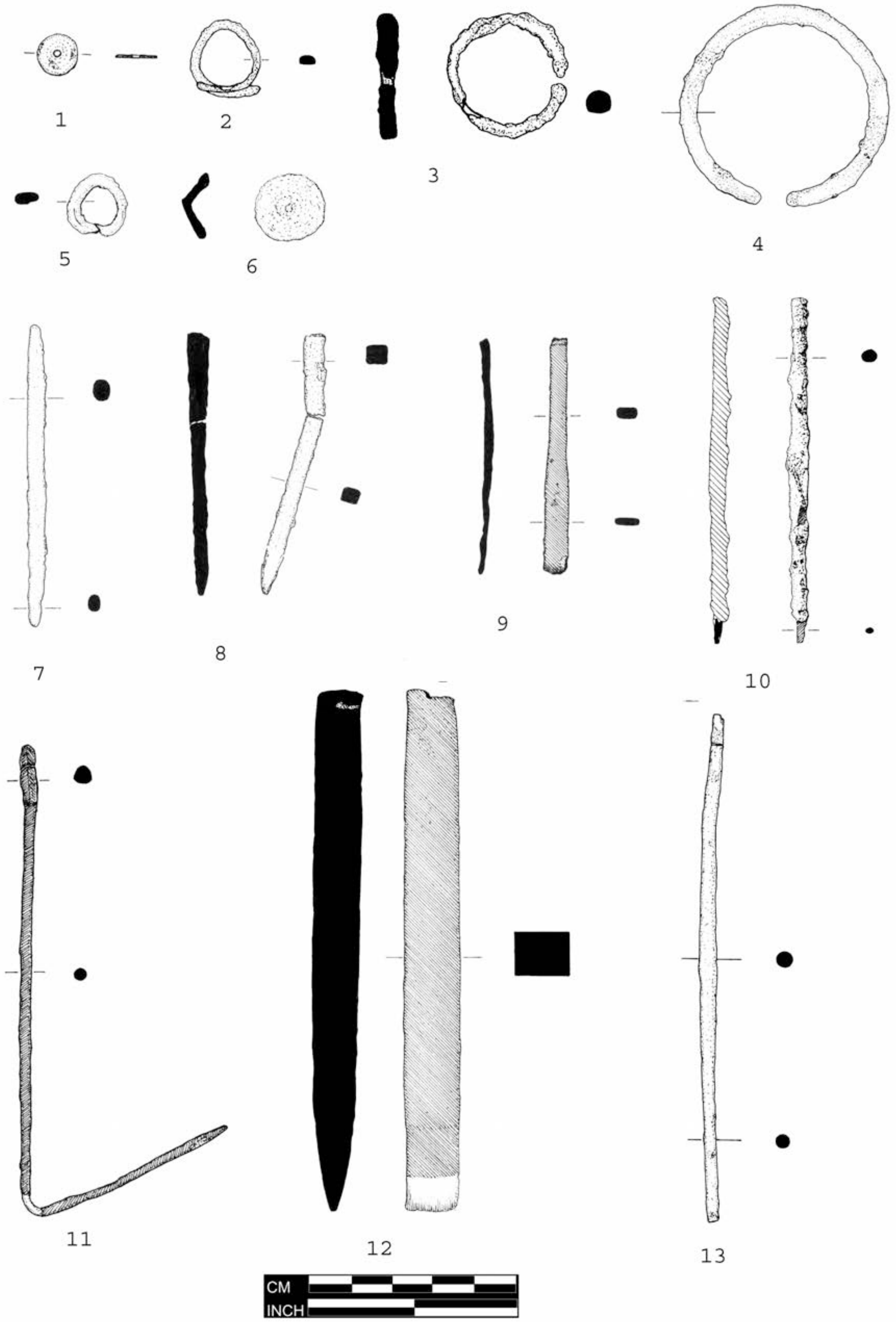
Another important tool in this regard that has been constituted an important percentage of the total tool assemblages is the chisel. Mostly they are rectangular or square in section with uniform dimensions along the entire length, beside rectangular or square in section with flattened end also. Maximum chisels are either double sloped or beveled in nature, may be the flattened shanks are meant for fixing the handles. These chisel of various sizes denotes their variant

uses in respective materials. The pointed one perhaps for cutting stone or for single wood work and smaller ones are for engraving on soft materials like soap stones or on the steatite seals. Their general length varies from 5-10 cm although exceptions are there.

It may be mentioned in this context that most of the tools like knife, chisel, point etc. were fixed in handles and the tang was sometimes thicker than the table. Even some of them have left their impressions of work that have been taken from them. Regarding, other tool types, fishhook, simple hook, rod, antimony rod, bolt or nail spindle rod, cup shaped object deserve mention, and a few of them have been included in the study. Nails mostly occurred with or without bulbous head are almost broken in nature beside this; personal ornaments like bangles, rings both of coiled and simple type, pendants (only one piece), and few spacers may also deserve mention. Not only this, the site has yielded few animal figurines (presently kept in the National Museum) which will be included in the next phase of study as they will be in taken in possession.

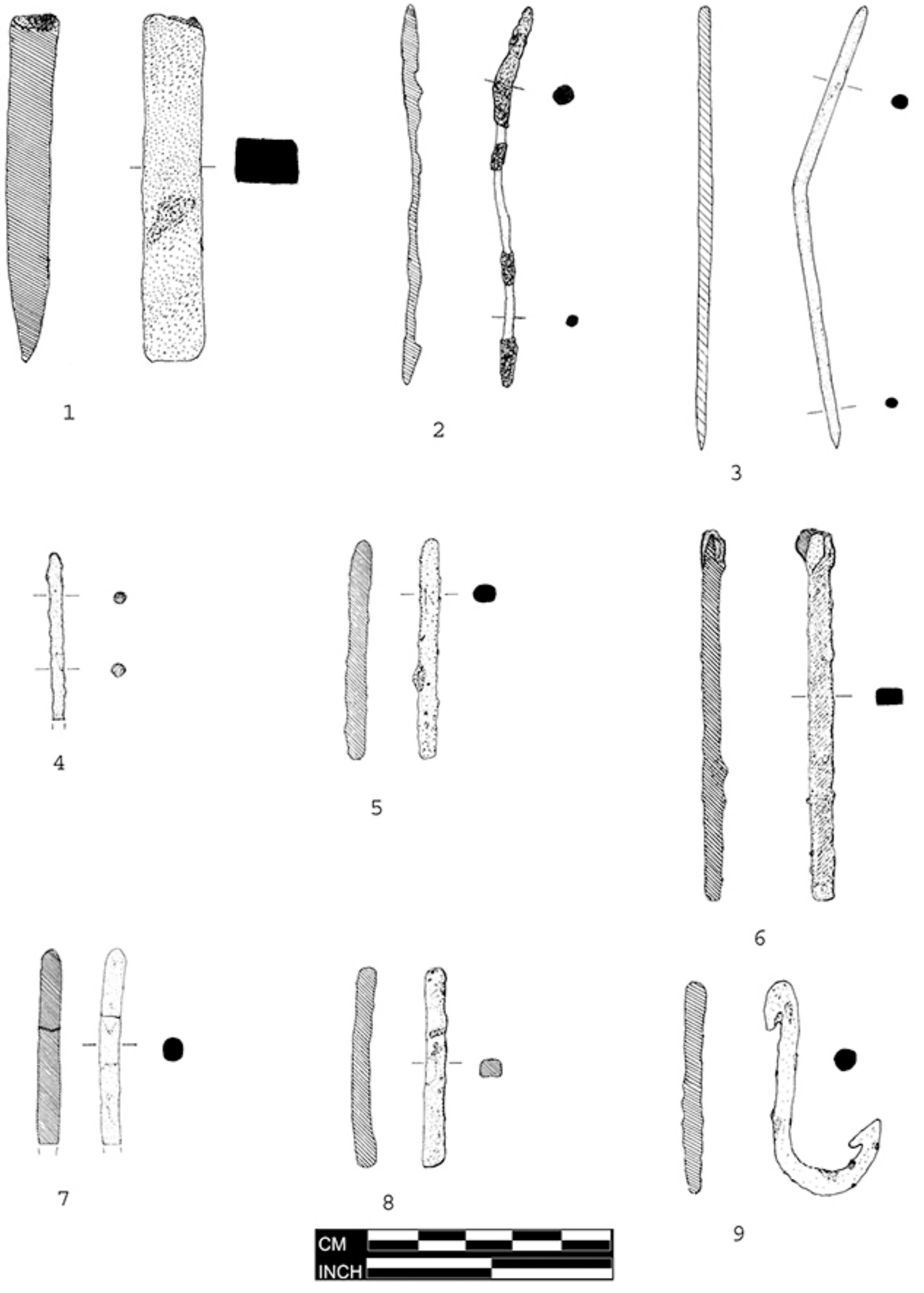
Along with these objects a large number of copper slags's and fragments of crucibles have been found that shows the local smelting of copper and its workmanship in Dholavira itself. Thus the availability of various developed and advanced copper objects clearly indicate the existence of a highly skilled group of copper smiths in the Harappan society who were also responsible for the first urbanization in the Indian sub-continent.

In terms of their metallurgical skill it has been proved that the Harappans knew the smelting of sulphides and copper ores, and most of the copper ores were exploited from Khetri mines. Further spectrometric analysis of certain copper objects have revealed that they knew the process of alloying, beside the technique of sinking, \`rising\` running on, cold work, annealing, riveting, lapping, closed casting and *cire perdue.* It may be mentioned in this context that a good number of metal objects which are presently housed at National Museum Delhi are not only unique in its type and nature, but they represent as few finest specimens of Dholavira.



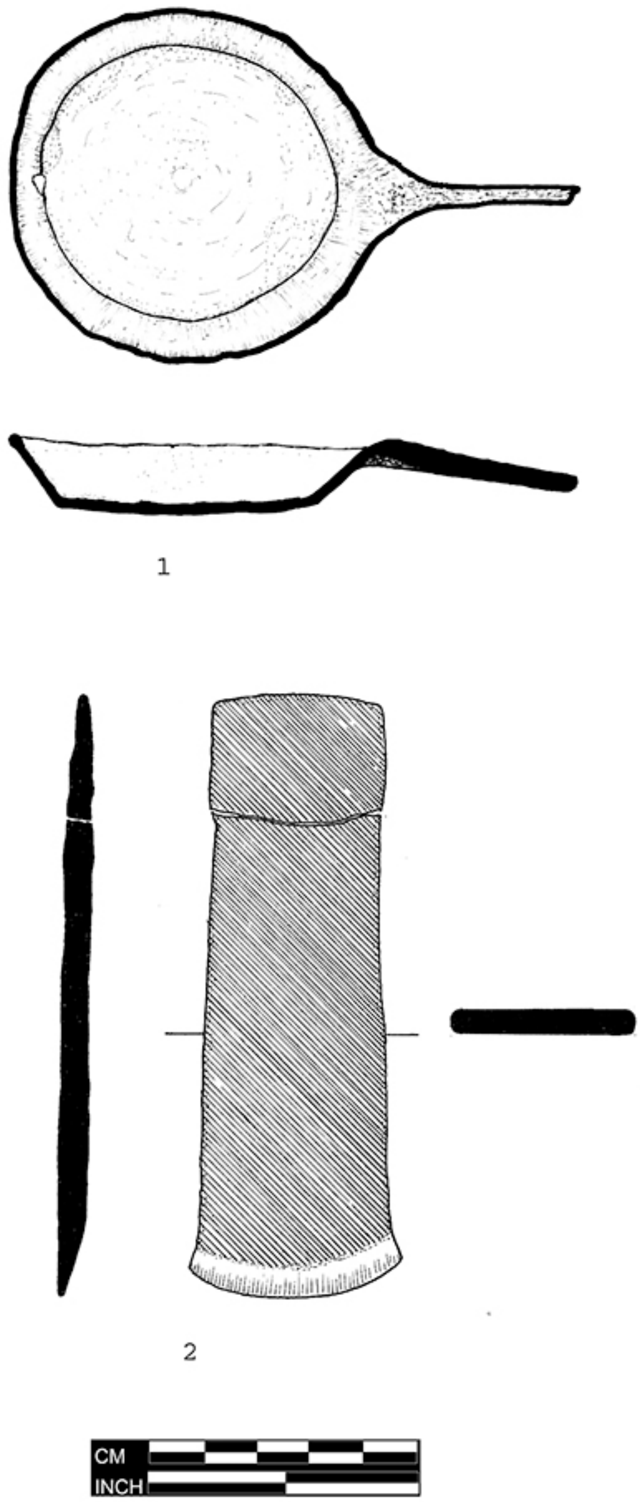
1 & 6 Button; 2-5 Ring; 7 Antimony Rod; 8, 10-11 Poiont
12 Chisel; 12 Rod

Fig. 8.227: Typology of copper objects



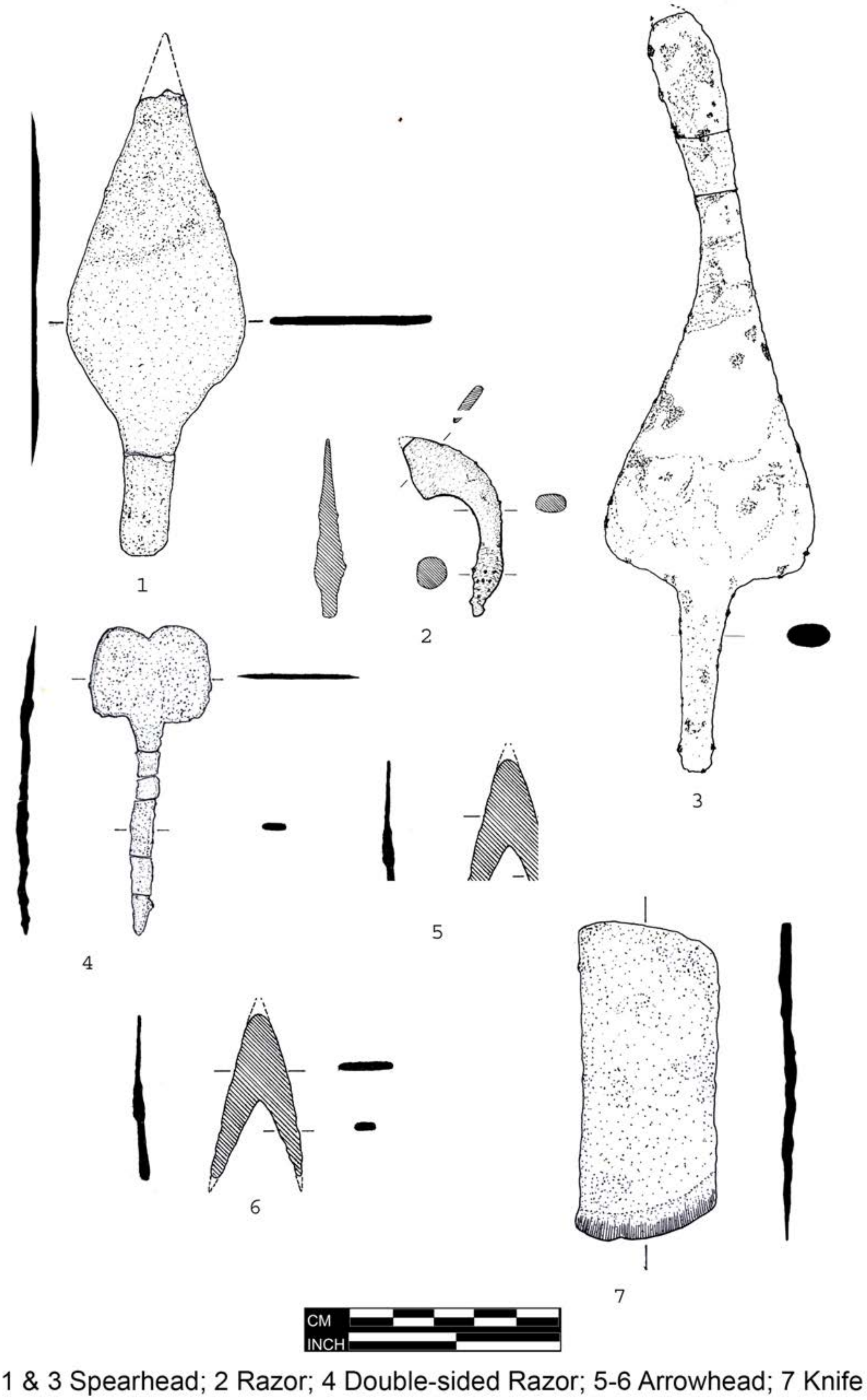
1 Bar; 2 Awl; 3 Kohlstick; 4-5, 7-8 Rod; 6 Nail; 9 Fish-hook

Fig. 8.228: Typology of copper objects



1 Fry pan; 2 Celt

Fig. 8.229: Copper utensil and celt



1 & 3 Spearhead; 2 Razor; 4 Double-sided Razor; 5-6 Arrowhead; 7 Knife

Fig. 8.230: Copper spearhead, fish-hooks, razor

8.6.2 Lead Objects

The Kutch Harappans used lead on a limited scale. Among the total items, 27 lead ores including small pieces, 1 rod like object, 2 cubical weights, one is very small in size, 1 sling ball, 1 circular disc, 1 stamp seal deserve mention. The number of lead ores found from the excavation confirms that the works of fabrication and extraction were done here. Beside this, 1 sheet tool, made on a thin lead sheet, one of the ends of which is rounded, another triangular, providing a pointed tip on the working edge, is also mentionable.

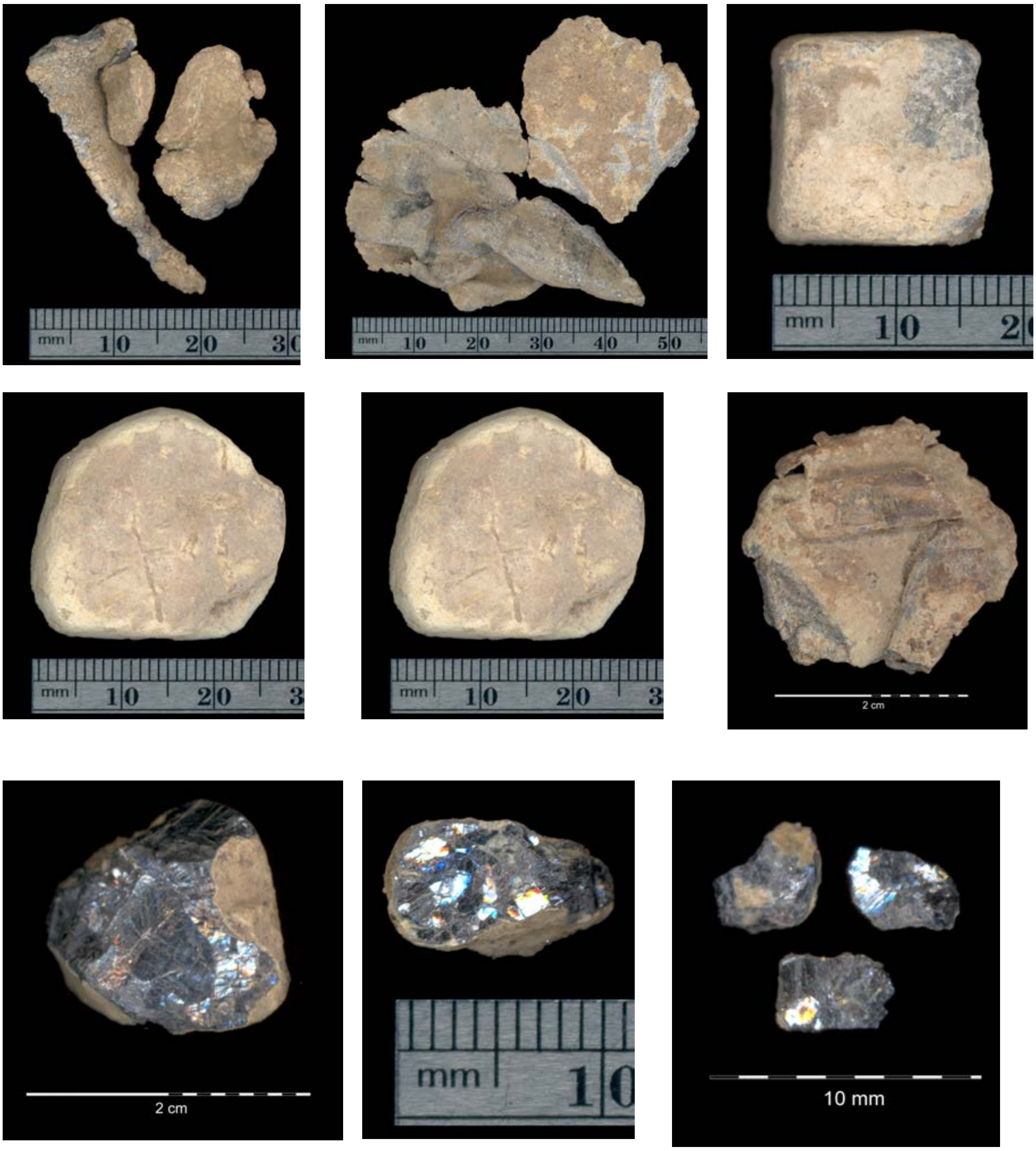


Fig. 8.231: Lead objects

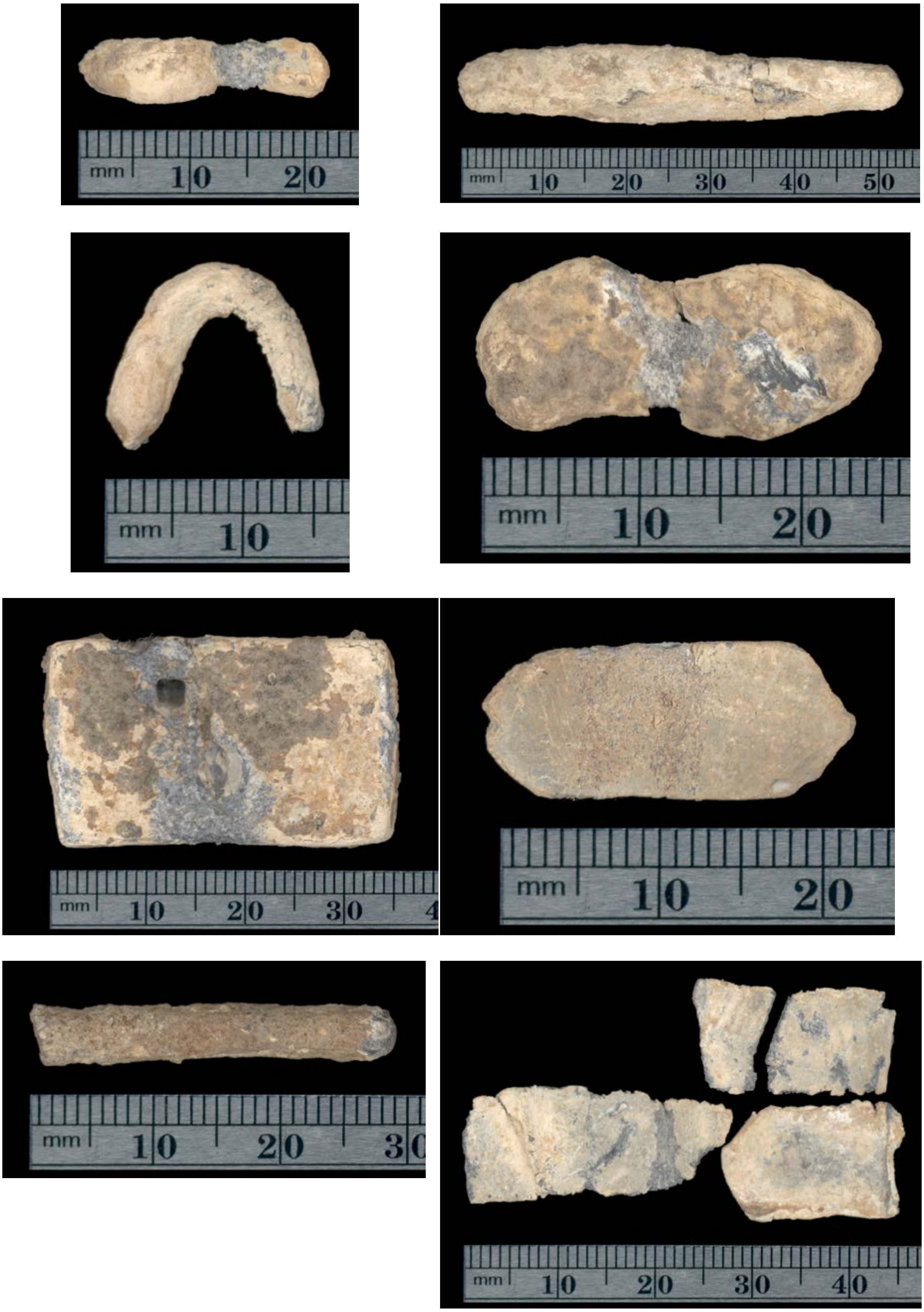


Fig. 8.232: Lead objects

The next solitary example is an arrowhead, having a tapering pointed, curved tip end, the other end is broken, which may have been provided with a tang. The credible source of lead in the close proximity is Zawar Mines in the Udaipur District of Rajasthan. In this context, it may be mentioned that, richest lead deposits in Udaipur, Rajsamand and Bhilwara districts of Rajasthan and from Ambaji in northern Gujarat to Sendra in the southern Gujarat comprising the locations like Amli-Mal, Kumbariya, Basantgarh, Birantia Khurd and according to Possehl (1980: 73) the sites like Dholavira, Nagwara might have accessed these deposits directly or via interaction with hunter-gatherer groups of the North Gujarat Plain. In course of excavation at Dholavira, one piece of Galena has also come across, which is one of the main ore bodies of lead.



Fig. 8.233: Lead objects

Forty lead objects were recorded. Four or five of them (all recovered from surface or near surface contexts) appear to be lead shot from the modern era. Among the nine unmodified lead minerals recorded are examples of galena (lead sulfide), cerussite (lead carbonate) and massicot (lead oxide). The remaining

artifacts are all lead metal and include rods, rings, sheets, ingots, bars and nondescript melted lumps.

8.7 Luxury Items: Gold, Silver Objects and Pendants

8.7.1 Gold objects

Gold work had been a very ancient industry in India. Right from the Harappan period it remained an important item, mainly used in ornaments, the artistic skill of the jewellers are evident from the personal ornaments found at different sites. In every Harappan sites gold in any form has been resumed, of course not in a large scale. Among the Harappan sites, Dholavira has yielded 123 gold thin foil, 116 beads and micro-beads, 6 rings including a spiral one, 1 spacer, 1 disc like object. Gold foil probably made by beaten the sheet metal, frequently used for plating, for e. g. one copper bead plated with gold sheet or foil has been found here. In this case, the work is done by the goldsmiths with adequate skill and knowledge, otherwise it may be broken, and as it is a very softer metal. Regarding beads, the mid-rib concealed the joints and in every case, joining was done either by sweating or soldering for which controlled heating is needed. Here, at Dholavira a cup shaped gold bead is found in which welding is done at the centre of the inner side of the bead.

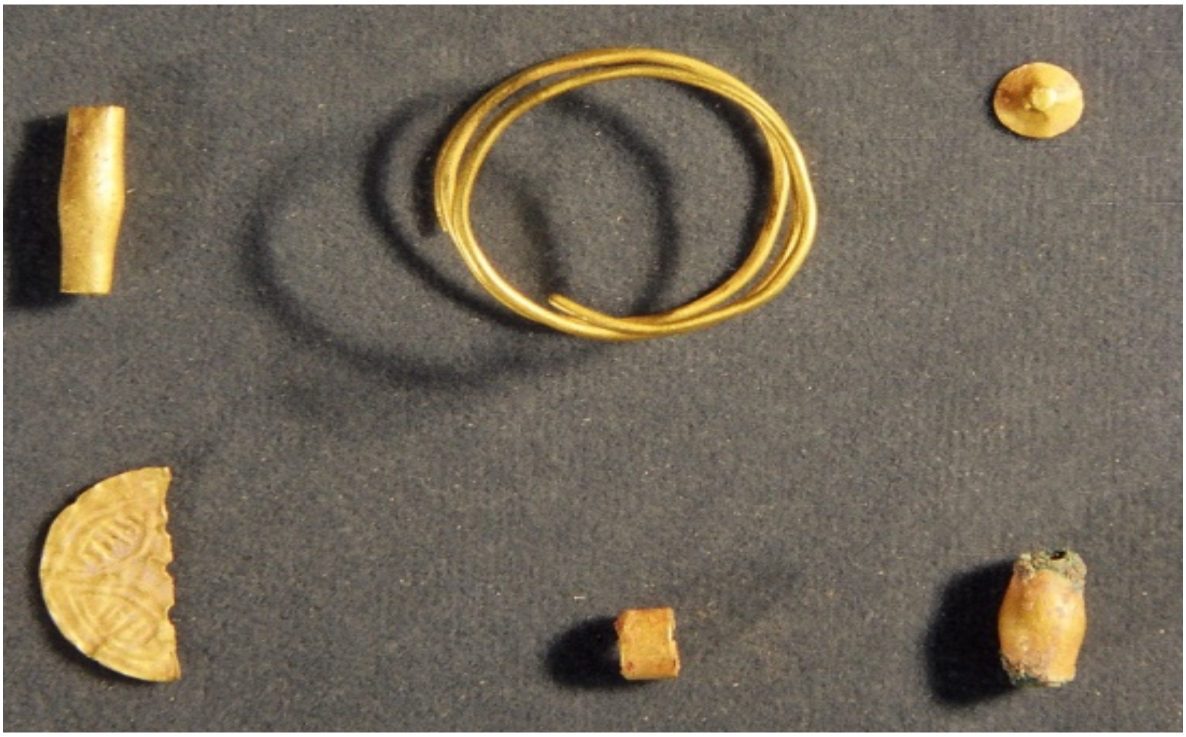


Fig. 8.234: Gold objects, Dholavira



Fig. 8.235: Gold objects, Dholavira

As far as the working on rings and spiral or coiled rings is concerned, the use of alloy for soldering Between the spirals of rings must have been applied. Until and unless the chemical analysis of these objects is being done, it is not possible to say what kind of alloy had been used. Spacer may be used at the centre of a necklace.

The Dholavira specimen bears four perforations in a juxtaposing manner. In appearance, the gold objects bear a whitish look; probably suggest the use of silver or lead alloy. Generally, gold occurs in the reefs and veins of quartz of the Dharwarian rocks of southern India, beside the alluvial gold washing is reported from the river beds as secondary deposits .But in Gujarat, recently, the gold mining has been resumed in the gold-bearing quartz veins of Alech Hills in Jamnagar District.

8.7.2 Silver Objects

Silver objects are very rare at Dholavira. Out of four silver objects, only one short, truncated, convex, bicone, one side damaged, bead is found. Rests 3 are small, fragmented pieces of thin silver sheets. The possible nearby resources can be the Kolar gold mines in Mysore or the Jawar mines in Rajasthan, where rich

silver production from argentiferous lead is evidenced. As far as the Harappan Civilization is concerned, the main source of silver is evidenced from Afghanistan and Iran.



Fig. 8.236: Silver objects, Dholavira

Of the 15 silver artifacts recorded, just over half were beads. The remaining items included coils and sheet fragments. Corroded fragments of a silver wire were found inside a vesuvianite-grossular bead. A piece of this wire was examined at the University of Wisconsin-Madison using EMPA and found to be 94% pure silver.



Fig. 8.237: Silver objects, Dholavira

8.7.3 Pendants / Gamesmen

The 235 small objects recorded in this artifact category have been called by researchers both pendants and gamesmen. The majority (n = 143) is composed of igneous rocks –basalt and gabbro. Notable within this subgroup there are some examples with an exquisite fine-grained black and yellow texture that have only encountered at Dholavira. Forty-two examples recorded were composed of siliciclastic sedimentary rocks (quartzite, sandstone, siltstone), 16 of limestone (micritic and nummalitic), 11 of agate or jasper and 1 of calcite. All of the materials mentioned thus far are available in the Kachchh region. Craftsmen at Dholavira would have had to import material from much more distant sources (to eastern Gujarat or beyond to Rajasthan, Balochistan or Oman) in order to create pendants or gamesmen from serpentine (n = 12) or steatite (n = 10).



Fig. 8.238: Pendants / Gamesmen, Dholavira

References

1. Geology and Mineral Resources of Gujarat, Daman and Diu, "Geological Survey of India Miscellaneous Publication "No. 30, part XIV, P.60, Gandhinagar, 2001

8.8 Figurines

Harappa and Mohenjo-daro yielded a huge corpus of human, animal and bird figurines in terracotta, faience, copper, steatite, shell and bone which were distinct in modelling. Later on, many other Harappan have been excavated in India and Pakistan, and even Afghanistan. Looking at the material it came clear there have been regional variations. Harappa and Mohenjo-daro and the other cognate sites in Sindh, Pakistan, Punjab and the Kachi plain(Nausharo) more or less form one group while those on the Indian sites particularly in the Ghaggar-Hakra basin as well as Lothal in Gujarat make another group. Their is profusion of animal and avian figurines which have turn up in.

Harappan art in the figurines made of terracotta, stone, metal, faience, steatite, shell and bone on one hand and surface decoration, in jewellery in their seals and tablets, pottery forms and in elements of architecture. On the other plan there is elite art in contrast to that of the commoners, which can be treated as the art of high order and art of low order. Besides, some are ideologically and ritually controlled while the bulk may be aesthetic or just playthings for the children, although sometimes it becomes difficult to draw a line. However, all above is the Harappan art in general. One point that can easily seen historically is the simple distinction Between the art of high order vis-à-vis low order in the realm of religious ideological and ritualism, that are best reflected in the contrast that is clearly visible in the terracotta art on the one hand, and those made on stone and other media (metal included).

While the terracotta art if made under religious ideology and not make as objects of past time and games, represents, by and large, the folk faith of a single or multiple communities living together at a given place or in a given area. as soon as some of the folk belief move on to a higher level of acceptability and universality, those are made most carefully and in Better media such as stone, metal and the like. A good example of that is the cult of Mahishashurmardini which moved on from clay to stone and to metal and then enshrined in temple, for a folk deity it is necessity of having an elaborate shrine. It can be worshipped at homes or at an ordinary place under a tree or whatever.

Terracotta figurines from Dholavira make it obvious that these form their own class both in modeling and decoration. As a matter of fact these cannot compete with those from Mohenjodaro, Harappa and other sites in northern domain in, so far as quantity, quality and general style are concerned although there are a few which come under the genre of the classical tradition. Barring such three pieces, all others all about a couple of hundreds fall in a regional folk art tradition for whatever use, ritual or playthings, or both. In terms of biological consideration, they are grouped under human, animal and avian figurines. Models of wheels are included for two reasons: firstly, many animal and avian figurines bear holes for an axle obviously to fit a wheel on either side for moving along; and secondly those are painted in colours like the figurines; for the same reason, the cart-frames to which some of the wheels should have fitted. There is a miscellany of other terracotta objects such as balls, pallets, hopscotches, etc which are left out only to be discussed elsewhere. In the total assemblage, animal figurines are predominant in number.

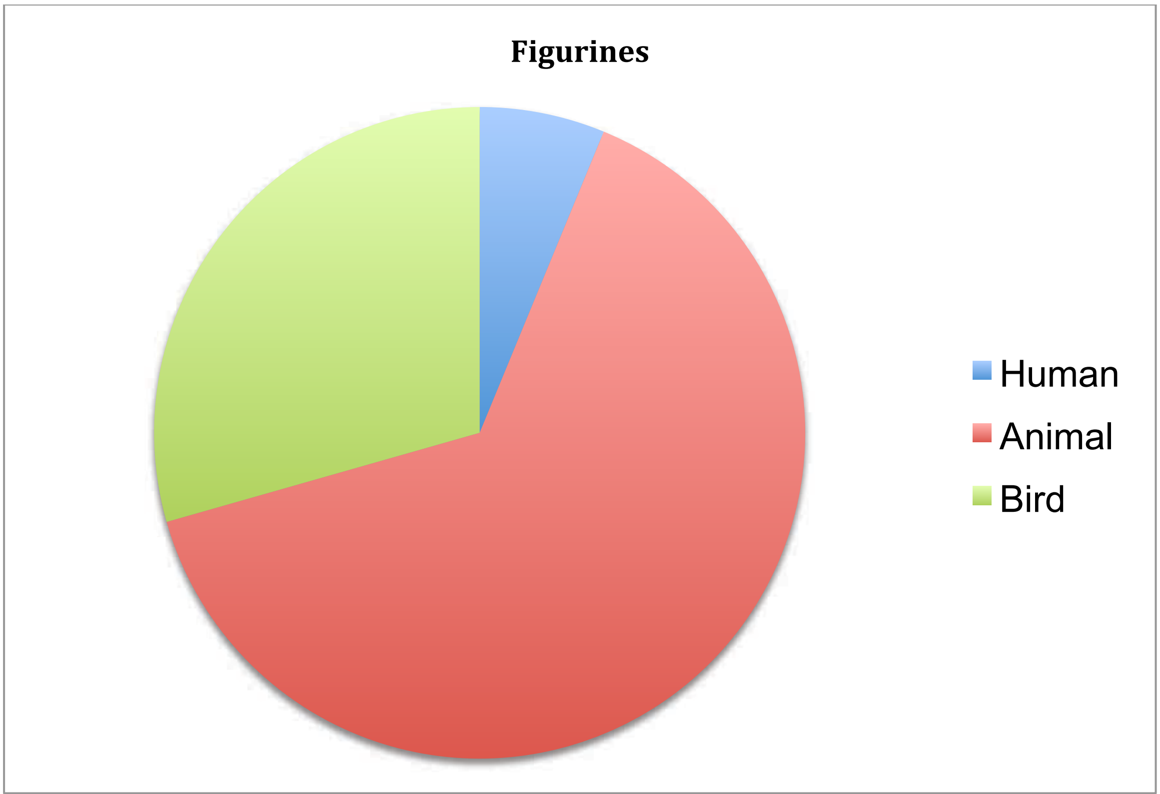


Fig. 8.239: Pie chart showing percentages of various type of figurines

Artistically, these are, by and large, much stylized although some bird figurines exhibit a kind of realism in modeling. In all two hundred eighty-nine

figurines of human, animal and bird in terracotta is found from the site. Looking into the broad classification it is seen that total human figurines are 18 (6.29%) in number, which is far quite less in number as compare to animal and bird figurine which are 186 (64.6%) and 85 (29.5%) in total number respectively.

8.8.1 Human figurines

In all, eighteen terracotta human figurines or detached limb parts have been found in varying degrees of preservation. No figurines are found in the first four Stages, i.e. Stage I, II, III and IV. Likewise, no such figurines could be found from the occupational deposits of Stage V, which have been largely exposed in the middle town, lower town adequately in the citadel and partially in the bailey. Similarly, no figurines could be collected from the localized layers of Stage VII, which were largely confined to the interior or closely adjoining areas around the circular huts. Two of the eighteen figurines are surface finds. The remaining sixteen need an in-depth discussion in order to assign them a cultural context because their possible relationship with a particular cultural Stage as a proper stratigraphical context is derivable circumstantially as follows.

There are as seven human figurines and three detached limbs, the later representing a foot, a hand and a badly mutilated torso have been found together in the fill of the northern drain which has just cascaded from a height and is due to meet soon with its eastern counterpart underneath a duct closely in the broadway of the castle. These figurines were found along with curious things like miniature Harappan pottery forms, a dish-on-stand with a series of lamp like attachment round the rim of the dish and decomposed organic material. The whole context indicates that they were, perhaps, part and parcel of an one-time ritual after which they might have been immersed in the water that was running or stagnating in the drain which had already become defunct due to collapse of the side walls and capstones at several places further ahead, sometime during Stage V itself.

Delineation of bodily outline from the shoulders to the thighs of all these human figurines is pleasingly curvaceous, particularly in the case of female figurines. Although other anatomical details are rather carelessly executed; the front and backsides are flat; head and facial features, hands and feet are far from being real and artistic as fingers and toes are not attempted at all and there is a little effort in giving shape to head, nose, eyes and mouth. These are tried by way of pinching thus causing a ridge for the nose and lips and the resultant depressions for eye sockets. If any clay pallets were provided in these sockets those have since got detached and lost. The breasts are made likewise by applying small lump of clay, and the bonding is so weak that in many cases one or both are now missing. Hands end up abruptly like spatula. Similarly, the ears are not visible now, if at all attempted originally.



Fig. 8.240: Human Figurines, Terracotta, Dholavira

As far as ornamentation is, concerned clay bands in appliqué are used to shown necklaces, girdles and anklets. Two examples of female figurines are shown bearing four necklaces round the neck and three strings hanging over and below the breasts. In one case, all the strings are extremely thin and carefully applied; and the outermost string is furnished with five pendants. An anklet may

be seen in the solitarily intact foot that was detached from a small figurine. While females are consciously identifiable due to the presence of breasts or their traces in addition to the nice curvaceous bodyline and heavy ornamentation, the lack of these features help identify the solitary male figurine.



Fig. 8.241: Human Figurines, Terracotta, Dholavira



Fig. 8.242: Human Figurines, Terracotta, Dholavira



Fig. 8.243: Details of a Human Figurine, Terracotta, Dholavira

All these figurines are made of greyish white kaolin, and are somewhat indifferently fired showing the unoxidized core. All figurines are in standing pose, the only exception is a small figurine in seated posture. In a few cases, the part of body is affected by smoky flame while baking. Traces of pinkish red slip are visible here and there on most figurines. The slip has however, suffered extensively because of the objects being buried in moist acidic soil for millennia. All these, therefore, appear rather weathered and washed.

As these figurines have not come up from any firm stratigraphic context, those can only be examined on the basis of the circumstance of their occurrence. The pottery, particularly the miniature forms of dish-on-stand, perforated jar, pear-shaped jar besides a carelessly made platter on a wide stand, and being furnished with a series of small cup-like forms round its rim, could as well belong to Stage V or VI. The whole context requires a deeper scrutiny. The drain seems

to have been visible to the inhabitants of both Stage of V and VI, and both of them had tried hard to revive it but all in vain. In this regard, mention should be made of three other figurines, which, too, are found from two different and equally tentative contexts. The find spot of each of them lay where the layers of Stage V and VI meet each other intimately.

One such figurine, of similar size and fabric was reported from a layer that was composed of a partially eroded material lying close to a late Harappan house of Stage VI. It was constructed on a filling of what was obtained by way of wreaking extensively and deeply the debris of Stage IV and V from the other, i.e. the southern side of the broadway.

The second figurine is of red clay but with unoxidized core was collected from near the southern arm of the castle, some 50 m away. Here, too, the context was not very certain as the late Harappan structures were overlying the partially robbed ones of Stage V. This figurine, too, was not only treated with red slip but also conformed in shape, size and style to what were collected from the aforesaid drain. The third figurine was collected from the subsurface layer 3 from near the south-eastern inner corner of the fortification of the castle, where the late Harappan house walls are found abutting on the defensive wall.

In this connection, it is most relevant to record that no such figurines have been collected from habitational layers of the residential houses and streets of Stage V, which have been extensively exposed in the middle town, lower town and bailey. All those, which have come up from the castle, appear from the contact zones where Stage VI structures overlay the filling debris or mostly from the drain which was certainly standing out exposed as it did even when the area had not been excavated. It would, therefore be safer, and even logical, to assign the human figurines to Stage VI during which its cult seems to be in vogue. Perhaps, the most deciding evidence has come from the drain itself.

A little downstream the same drain, when both the eastern and western arms had already met each other, has yielded a truly late Harappan seal, quite close to the find spot of the female and male figurines along with the ritual

wherewithal. Thus, we hold that all the human figurines represent a cult that was in vogue during the late Harappan time of Stage VI. Another important thing need to be mention here that from the point where choked western drain of castle meets with the northern drain we had found a small late Harappan seal near to the place were all drain figurines were found deposited.

It is worthwhile to reinitiated that no terracotta human figurine have been collected from any other stage than the Stage VI.

It is significant to note that the other sites in Kachchh, namely Surkotada, Desalpar, Pabumath, Shikarpur and Kanmer have not yielded any human figurines while Lothal has offered a few crude ones, which stand no typological comparison to those from Dholavira. The solitary female figurine from Kuntasi (Dhavalikar et.al 1996: 246, fig.7.44.9 & 7.45.9) has come from period II, i.e. the late Harappan.

8.8.2 Animal figurines

During the course of excavation, approximately one hundred and eighty-six animal figurines were reported. Under the succession of seven Stages, it is found that no figurines were found from the levels Stage I and II. While, Stage III possess only three examples however on the other hand Stage IV and V dominate the whole assemblage possessing thirty-seven and thirty-five figurines respectively. So, far Stage VI is concerned twenty figurines are reported and Stage VII possess single one. Looking into, its area wise distribution is showed that 52 figurines were found from the citadel, 82 figurines are from middle town area, and lower town contain 15 figurines. Apart from this, four figurines were from annexe area, four figurines found from reservoirs, one figurine from burial ground; two figurines were from drain of castle, and 30 figurines are from outside area of the outer fortification.

Most of the figurines were made up of sandy soil but some examples of kaolin made figurines are also present. Barring only two figurines, not all others

display the classical style. Besides there is fourteen animal figurines which were found coated with chocolate red slip along with painting in white and black pigment. Motifs included are generally horizontal and vertical strokes.



Fig. 8.244: Unicorn Figurine *in situ*, Terracotta, Dholavira



Fig. 8.245: Animal Figurine, Terracotta, Dholavira



Fig. 8.246: Ram Figurine, Terracotta, Dholavira



Fig. 8.247: Animal Figurines, Terracotta, Dholavira

It seems that majority of the figurines were stylized accompanied stumpy legs but in two examples of bull and sheep figurines, careful incision work was applied in their modeling, which reflects a kind of realism. Most of the figurines were in fragmentary condition, because of which their identification is quite difficult. However, it is observed that ram figurines were dominating the whole

assemblage followed by figurines of bull, dog and elephant along with single piece figurine of tiger head.



Fig. 8.248: Animal Figurines, Terracotta, Dholavira

8.8.3 Bird figurines

So far, there are more than eighty-five bird figurines found from the site. If we look into the chronological classification of figurines no figurines are found from Stage I, II, and VII, however from Stage III two figurines were found, on the other hand Stage IV and V contains nineteen and twenty-one figurines, respectively. Apart from this stage VI were having 14 figurines which are comparatively less in number as compare to stage IV and V. On the whole it is observe that Stage IV and V dominate the whole assemblage in style, variety, and number.

Area wise distribution, of figurines in citadel, middle town and lower town gives an idea that castle and bailey jointly contain 36 figurines. The middle town area of the city was having 37 figurines, while the lower town posses very meagre amount of figurines(only five). Apart from the said parts other areas of the city also contains figurines, like: the annexe having three and the eastern reservoir, stadium provide 2 each.

Looking at the typologically classification of these figurines, it is found that out of the total assemblage there is 25 examples of headless duck figurines, which are on stylistic ground stand apart. It is also examine that these duck figurines were in prominence followed by whistle birds and peacock figurines. Physical appearances of the duck figurine were quite different from peacock figurine. The duck figurines are shown with bulge body structure and were mostly slipped with bright red to dark chocolate colour slip along with painting in white pigment. All of them are having flat bottom and perforation were made where wings are made by way of using clay pallets or through incision.

Another thing to be notice is that mostly figurines belong to the duck category was having perforation just below their broad neck area. Perforations were provided generally to attach wheels and threads with figurines to make them to use as playthings. along with two broken peacock figurines. There are also 8 whistle birds and 23 head portion of unclassified (typologically) bird figurines. They are mostly devoid of any kind of slip or painting and hollow from inside. Figurines are broad from middle portion while pointed and thinner at both ends along with perforations. Another noticeable thing is that all these figurines are attached with small round kind of pedestal.

There also found 2 pedestal bird figurines of pigeon category and 1 broken tail portion of unidentified bird figurine.

Careful examination shows that more fine work was employed for the modeling of the bird figurines as compared to human and animal figurines. Figurines were generally made up of sandy alluvial soil and are well fired. Around 16 figurines are found to be painted with white pigment over red slipped surface but in one figurine black pigment were used over the cream slipped surface. The colour of slip is dark chocolate red. Painted motifs include horizontal, vertical bands and dots. Anatomical details like wings and eyes are made by way of incision and attaching clay pallets.

There is no attempt to make legs of any figurine but in one figurine, bird is shown with stumpy legs and stretched out wings.

So, far 3 broken terracotta peacock figurines were found from the collection in which one is the head portion and other two are bust portion of the figurine. Two figurines display application of slip and painting. The slight projection above the head and long slender neck of figurine confirm its being peacock figurine. Perforations were found in one of the figurine on just above the neck portion area like mostly found in duck figurines.

8.8.4 Toy carts and wheels

8.8.4.1 Toy carts

So far, until now more than two thousand pieces and fragments of toycart frame along with terracotta wheels reported from the site. The large number of findings suggested that like Harappa and Mohenjodaro the younger population of Dholavira also paid great attention towards their amusement activities. So long as the variety is concerned, the whole assemblage broadly comprises three categories of toy cart frames. All toycart frames are in fragmentary or broken condition and even some times found in such small pieces that it became hard to identify them as toycarts In fact no full-unbroken example found from the site.

The main varieties contains-solid frame type either concave or straight, perforated chassis type, and Cabin type along with this, various sub-varieties also found like perforated chassis variety. Mainly perforated chassis variety and its sub-varieties are found in abundance. Solid chassis frames both variety concave, flat one contains holes vertically, and horizontally, which was used for fixing wooden pegs and cross bars. These types of carts were usually found in Sindh region or Indus valley. Another variety is of perforated chassis type having different sub varieties mostly concave it is said that this variety mostly found in Kathiawar area. Third variety is of cabin type and only one example of this

category is found from total assemblage. Consider number of toy cart fragments was found painted mostly in white pigment and occasionally in black pigment.



Fig. 8.249: Toy cart frame *in situ*, Terracotta, Dholavira



Fig. 8.250: Toy cart frames, Terracotta, Dholavira



Fig. 8.251: Toy cart frames, Terracotta, Dholavira

8.8.4.2 Wheels



Fig. 8.252 Wheels, both with hub and spokes, Terracotta, Dholavira

As far as terracotta wheels is concerned more than five hundred terracotta wheels were reported from the site, their most probable use was defiantly as an attachment to toycarts frames/chassis. The whole assemblage possess three variants- 1) wheels with pronounced and sharp hub, 2) wheels with convex

surface at one side on the perforation point and lastly 3) the wheels with thin perforation and having both plane sided surface. Large number of wheels gives wide range of diameter from being very thin and small to large and thicker ones. The variation in diameter varies from 113.324 mm to 30.37 mm/17.27.

The width of wheels covers the range from 17.54 (without hub) to 29.40 (along with hub). Another notable thing is consider number of wheels was painted usually with white pigment and occasionally with red and black colour. Generally wheels are well baked having thick to thin fabric sometimes, even potsherds were employed for making wheels. It is observed that at least 50% wheels of the total assemblage were originally painted as paintings were very faintly visible, it might be possible that pigment were gone due to the action of water and wind. There is one example of wheel on which graffiti mark was inscribed reported from the middle town area (54x68x1) and likely to be of stage IV. Wheels on which painting were fairly preserved are total thirty in number and majority of them were from middle town.



Fig. 8.253: Spoked wheels, Terracotta, Dholavira



Fig. 8.254: wheels, Terracotta, Dholavira

8.9 Stone objects

There are five hundred and thirty six (526) stone objects of various types manufactured out of a variety of sandstones and limestone. Much of the material is locally procured and manufactured. Some of the objects indicate its origin outside of Khadir Island. In view of their use, form, and, in some cases, taking into view of their *in situ* position, those have been divided into following three main types.

The stone objects have been broadly divided into three main groups, viz., utility tools and equipment, architectural elements and miscellaneous objects.

8.9.1 Utility tools and equipment

1.	Mortars	6
2.	Querns	82
3.	Mullers	115
4.	Pestles	12
5.	Bead polishers	28
6.	Whetstones	6
7.	Ringtones	14
8.	Pellet	3
9.	Sling Balls	66
10.	Dabber	2
11.	Anvil	4
12.	Pounders	26

8.9.1.1 Mortars

Mortars are six (6) in number represents both big and medium in size that varies from 46 x 26 cm-17.5 -10.2 cm. They are circular, elongated and square in nature. The elongated one is having an opening at the top and a circular band in relief near the outer surface and flat base.



Fig. 8.255: Mortar *in situ*



Fig. 8.256: Stone mortar

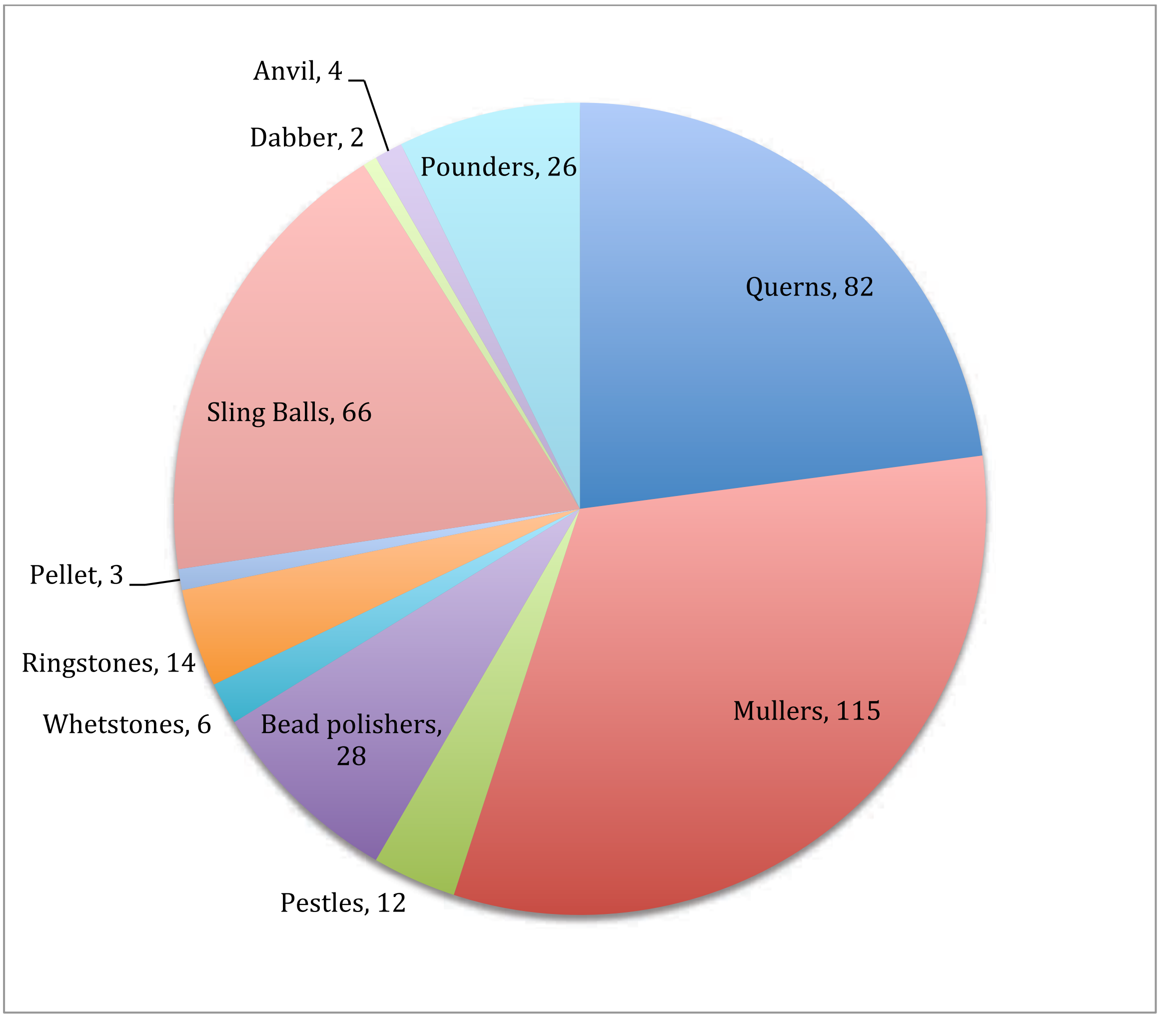


Fig. 8.257: Pie chart showing the types of stone objects

8.9.1.2 Querns

Querns are about eighty two (82) in number, prepared out of quartzite, sandstone, quartzite- sandstone, and lime stone of both banded and plain types. In each category of querns there are four-sub type like flat base, saggar base and long leg on saggar base. Their maximum length varies from 58 x38 – 15 cm to 24 x 23.5 - 4 cm. The smallest one shows 8.5 x 12.5 – 4 cm. While the first and second group of querns will stay firm on the ground, the third one was to be driven partly into the ground before being put into use.

Repeated use of these querns perhaps mostly of the grains caused deep depression in the middle. Sometime the entire surface demonstrates a stiff curve of a horse saddle. In certain cases only the margins are as raised as higher that of the original shape. Even in few cases grinding was done in such a manner

that the flat or sunken surfaces have developed different kind of localized grooves.



Fig. 8.258: Various types of querns



Fig. 8.259: Various types of querns



Fig. 8.260: Various types of querns



Fig. 8.261: Saddle querns



Fig. 8.262: Various types of querns



Fig. 8.263: Various types of saddle querns

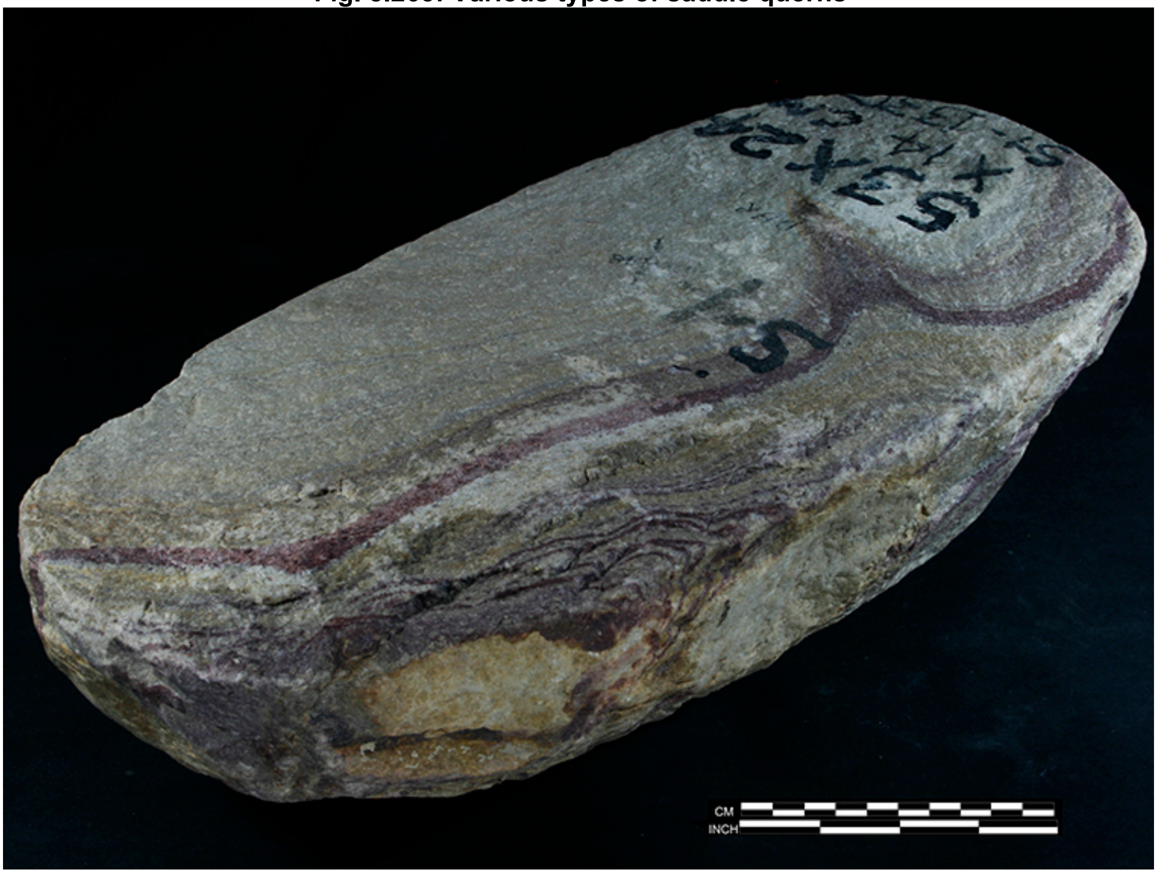


Fig. 8.264: Saddle quern

8.9.1.3 Mullers

Mullers have been found maximum in number (total 115 were recovered from the excavation) that mostly made out of sand stone consists of various shapes and sizes, like rectangular, oblong, barrel, cylindrical and ovoid. Possibly the present shape and forms of the grinders were the result of their constant use. In few cases probably they are prepared out of natural stone found from river bedside. The larger one measures 24 x 8 x 4.5 cm and the smallest one 6.5 x 5 x 3.8.



Fig. 8.265: Various types of mullers



Fig. 8.266: Various types of mullers

8.9.1.4 Pestles

Pestle (pounder) total no is nine (9) length varies from 17.5 x 78.3 x 4.2 cm mostly made of elongated shaped stone blocks of different shapes and sizes like cylindrical, elongated and rectangular with bulbous, circular and flat ends. Most of the objects are having medium to deep battering marks indicating their prolific use.



Fig. 8.267: Various types of pestles

8.9.1.5 Bead Polishers

Sharpener (bead polisher) prepared out of coarse sand stone is tentatively twenty seven (27) in number and are of two types that based on the grooves size like broad (7-3 cm) and narrow (below 3 cm) which stylistically are circular and fluted in appearance.

Such kind of groves perhaps indicates the type of object that applied on the surface like semi-precious beads and shell object etc. Their shapes vary from square to oblong, rectangular and irregular.



Fig. 8.268: Bead polisher



Fig. 8.269: Bead polisher



Fig. 8.270: Bead polishers

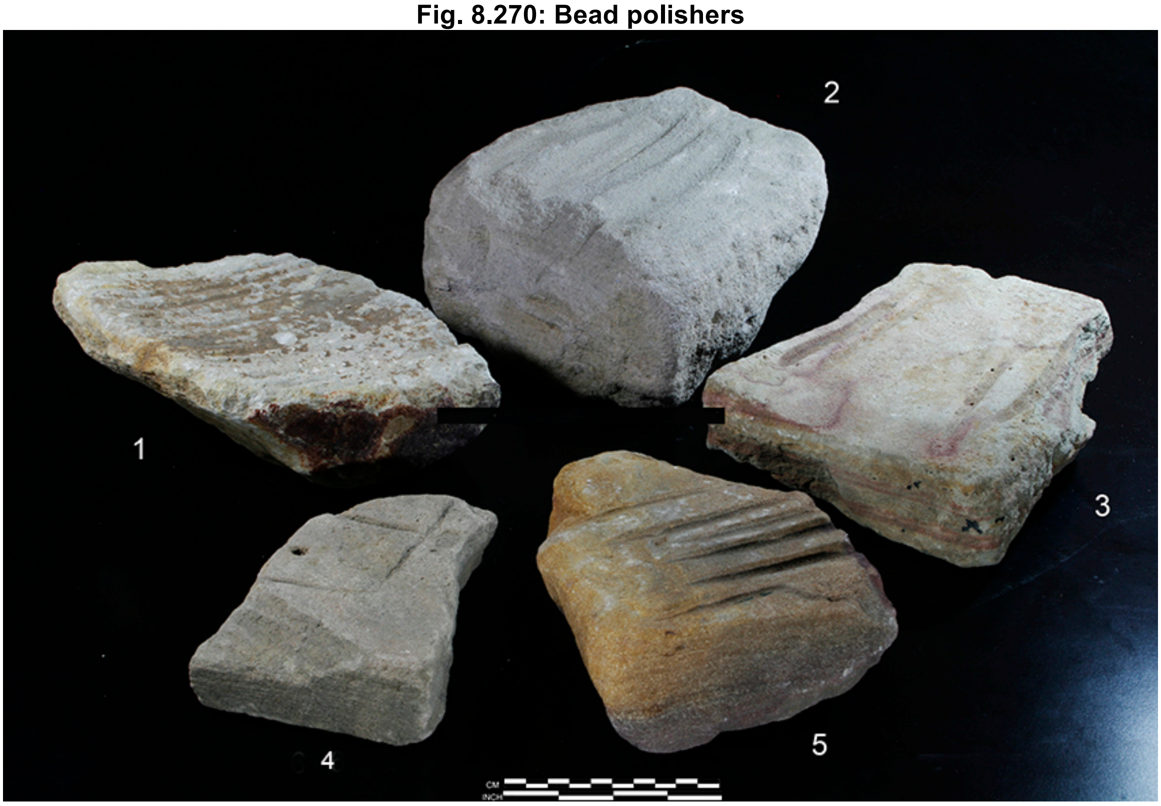


Fig. 8.271: Bead polisher (except 4)



Fig. 8.272: Bead polisher *in situ*, Bailey, Dholavira

8.9.1.6 Whetstones

Whetstones is sixty (60) in number, among which the larger one is 19 x 0.5 – 2.2 cm and the smallest one is 7 x 6.5 – 4 cm. prepared mostly out of sand stone found is various shapes like triangular, ovoid with rough flat surface. In this context mention may be made of one small and handy piece (8.2 x 5.8 x1 cm) with curve groves in the surface probably for taking into grip where both the sides were taken into use.

8.9.1.7 Ringstones

Ringtones, altogether ten (10) in numbers, fashioned out sands stone and limestone, which include both finished and unfinished in nature. Out of ten five are intact and remaining five is broken. All of them having a perforation in the middle, which are distinctly shows in 3 piece and semi prepared in remaining other piece. Their maximum diameter diverges from 11.5 – 10 cm and thickness

from 4.3 - 1.3 cm. In few case both the surface are uniformly sloped towards the outer periphery, but in others mostly damaged along the periphery.



Fig. 8.273: Ringstones



Fig. 8.274: Ringstones

8.9.1.8 Dabbers

Two Dabbers (2) have been recorded, one small in size, partly broken having bulbous circular rough end with a flat top used for handhold. The other one made of fine buff colour stone, upper part missing; only the rounded lower part remains. Dia. 7.8 cm, thickness 4 cm.

8.9.1.9 Pellet

A single piece of pellet is found which is made of fine smooth black stone, ovoid in shape and a mild depression in the canter used for preparing medicine measuring 11 x 9 x 3 cm.

8.9.1.10 Sling balls

Sixty six (66) sling balls in number were found of various sizes and shapes like semi spherical, spherical and a few are ovoid that prepared out of sand stone and limestone.



Fig. 8.275: Sling balls

8.9.1.11 Anvil

A single example found in the collection, it is prepared out of sand stone of buff colour, small in size, flat surface on both the sides rough rounded sides.

8.9.1.12 Pounders

Seventeen pounders have been found, probably used for grinding grains of various types, made of buff colour coarse sand stone, quartzite sandstone and limestone.



Fig. 8.276: Pounders

8.9.2 Architectural Elements

A large number of architectural members and elements manufactured out of the locally available limestone were encountered from the excavations. Many of these architectural elements are still lying *in situ* and based on the shape and functions the following broad classification is made:

1. Pillar Elements
    i) Basal Slab
    ii) Square Blocks
    iii) Circular Elements with concave profile
    iv) Truncated Spherical Elements
    v) Tapering Sided Elements
    vi) Short Cylindrical Elements
2. Free Standing Columns
3. Doorsill
4. Lintel
5. Pivot
6. Door stopper
7. Drain Elements

8.9.2.1 Pillar Elements

Several pillar elements have come into notice from the excavations at Dholavira. The most prominent among them being the architectural elements of various shapes and sizes, some of them noticed *in situ* in their original position and condition. These pillar elements have come mostly from the North Gate and East Gate of Castle. The *in situ* pillar elements clearly indicate the nature of position adopted for each shape of the element for the architecture. The evidence from East Gate of Castle wherein pillar elements of three different shapes are preserved *in situ,* the order in which they were used in the construction is clearly established. The evidence indicates the use of square blocks at the base followed by bi-concave element and finally truncated spherical element. These pillar elements could have been affixed together by wooden pegs as indicated by small circular motive and tenon holes in them. The evidence also indicates that upon the truncated spherical pillar element, a wooden log could have stood supporting the roof of the chambers. These pillar elements, three in order of one above the other, rests on a basal slab, often a long rectangular stone piece. The position of these pillar elements on a firm

footing clearly indicates the understanding of the implications of distribution of weight and sagging of foundations by the Harappans, and hence they had made this extraordinary arrangement.

8.9.2.1.1 Basal Slab

As mentioned above, the provision of basal slabs, often a large rectangular stone element has been noticed at all prominent architectural edifices at Dholavira. These basal slabs provided a very good firm footing for the superstructure. These basal slabs were fashioned out of the limestone blocks, which are available in plenty in the island of Khadir itself. This is also substantiated by the presence of at least two quarry sites, with plentiful evidences of quarrying massive stone blocks, chipping and finishing them. The basal blocks are not fully smoothened and polished as noticed in the case of other pillar elements. The basal slabs were left unfinished with irregular and rough surface and functionally always concealed.



Fig. 8.277: Location of basal slab *in situ*, North Gate, Castle



Fig. 8.278: Location of basal slab *in situ*, East Gate, Castle



Fig. 8.279: Location of probable basal stone and later robbing

8.9.2.1.2 Square blocks

The next stage in the arrangement of pillar elements is a square block, which is also manufactured with the locally available banded limestone from Khadir Island. These stone blocks were found in a highly smoothened and polished surface. The top surface of some of the square blocks is also provided with two long linear grooves on each on either side as is indicated from the *in situ* ones in east gate of Castle. The square blocks with two grooves on the edges are found along the plaster side of the chamber in east gate, while the square blocks, which formed part of the composite column, members are devoid of long grooves and are found placed at the central portion. The square blocks did not make a complete cube as their height is found to be nearly 1/3rd of the length.





Fig. 8.280: Location of square blocks *in situ*, East Gate, Castle (left); North gate (right)

8.9.2.1.3 Circular elements with concave profile

The next pillar element found on top of the square element is an interesting and highly conceived geometrical shape, which can be defined as a circular element with concave profile. This shape is also quite interesting, as it

resembles a pottery ring stand, which was normally used as a stand for large globular pots resting on them. It may be interesting to also note here that a vertical profile of such a pot resting on a ring stand will create an impression of a truncated spherical pillar element resting on a circular element with concave profile.



Fig. 8.281: Circular element with concave profile

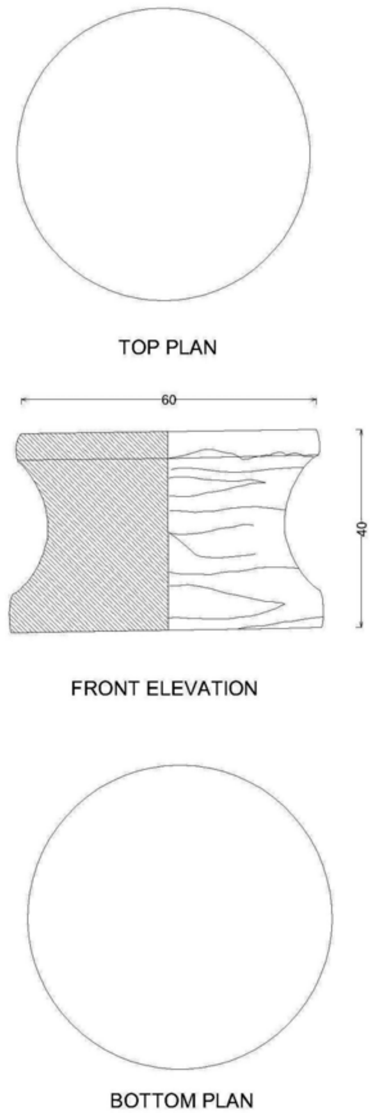


Fig. 8.282: Plan and elevation of concave profiled element

The shape of this pillar element is circle, with a concave profile, the base and top surface being flat with chamfered edges. The concave profile of this pillar element has a top and bottom circular discs, the diameter of the bottom is larger than the top surface. Further, the chamfering of the top surface is inclined inwards, while the chamfering of the basal portion is more or less straight. This stone member does not have a mortise hold at the base, while at the top surface a mortise hold of 6 cm diameter is noticed.

The lower diameter of the stone member is 62.5 cm while the upper diameter is 60 cm. The height of chamfering at both top and bottom is 5 cm. The

overall height of the pillar member is 40 cm while the diameter at the centre of concavity is 48 cm.

So far four complete pillar elements of this type has been found, one *in situ* in the east gate, another one found in a dislodged position in north gate, third one in a secondary context of a lapidary workshop of Stage VI near the west gate of Castle and the last one collected from the exploration from Dhundrimal located at a distance of nearly 3.5 km to the east of Dholavira.

8.9.2.1.4 Truncated Spherical Element



Fig. 8.283: Truncated spherical element

The next in series of the pillar components is a finely shaped and finished pillar element in the form of a truncated sphere. The overall finish and

smoothening on the surface of this pillar element as well as the concave profiled one indicates a mechanised technique of turning them similar to a lathe.

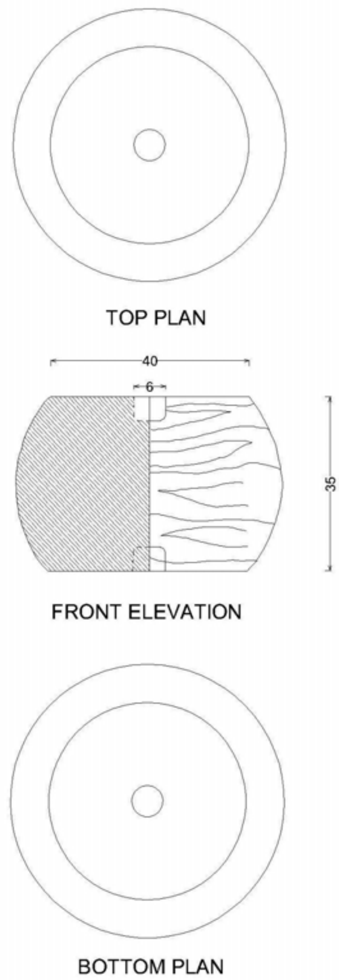


Fig. 8.284: Plan and elevation of truncated spherical element

This pillar element has a convex profile with a flat top and base. The overall height of the pillar element 35 cm, the diameter of top and bottom surface is 40 cm while the diameter at the centre is 55 cm. The central portion of this pillar element on the top and base has a mortise hole with 6 cm in diameter. Four examples of this variety of pillar elements are known, two found in a dislodged condition in east gate of Castle, third one from north gate of Castle and fourth one from Dhundrimal site. Two more incomplete and unfinished ones of this variety are also found placed on either side of the passageway of north gate of Bailey.

8.9.2.1.5 Tapering sided element

This is a solid pillar element with tapering sides, the basal diameter being larger than the top diameter. One such pillar element is of particular interest, which has a height of 82 cm with a top diameter of 35 cm and a basal diameter of 45 cm. This example is of a yellowish limestone and was found from a secondary context in a bead workshop of Stage VI. This workshop was excavated near the west gate of Castle. In this workshop, along with this pillar element, other two pillar elements are also noticed, one of the concave profile circular and other of short cylindrical element. The fourth one is a large stone slap, rectangular in shape and could have been a doorsill.



Fig. 8.285: Tapering sided element in the foreground

8.9.2.1.6 Short Cylindrical Elements

Another variety stone elements are a short cylindrical in shape, however with a gentle inward tapering. An example of this kind of element was found in a secondary context from the lapidary workshop near the west gate of Castle. As mentioned elsewhere, this element was found along with other two pillar elements. The short cylindrical element is 38 cm in height and due to its tapering nature, the base diameter is 50 cm and top diameter is 45 cm. The exact function of this element is not clearly understood as it is not found *in situ* condition.

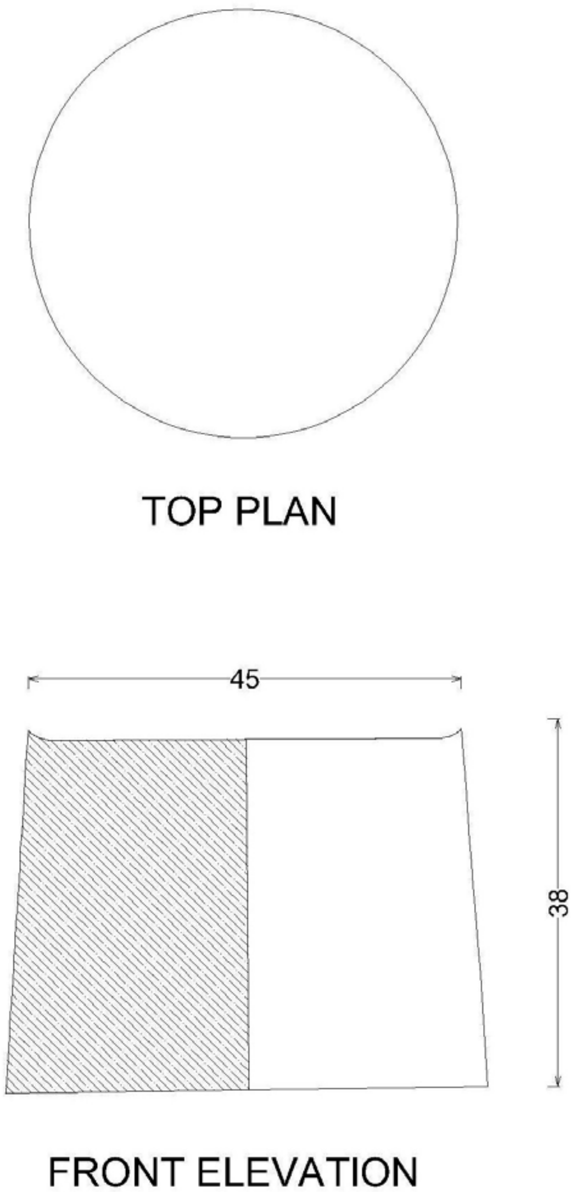


Fig. 8.286: Plan and elevation of short cylindrical element

8.9.2.1.7 Disc shaped element

The disc shaped element is another kind of pillar elements found from Dholavira, again not in a primary context and only in secondary context. This element is a short cylinder with straight sides. The example available is of a banded limestone, 25 cm in height with basal and top surface diameter is 45 cm.



Fig. 8.287: *In situ* location of short cylindrical element

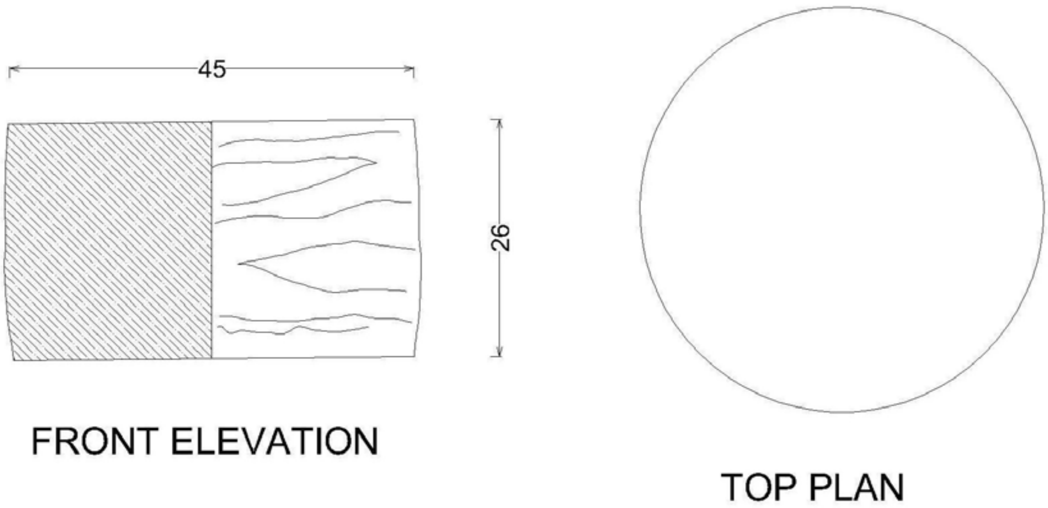


Fig. 8.288: Elevation and plan of disc shaped element



Fig. 8.289: Wavy pillar element from Harappa

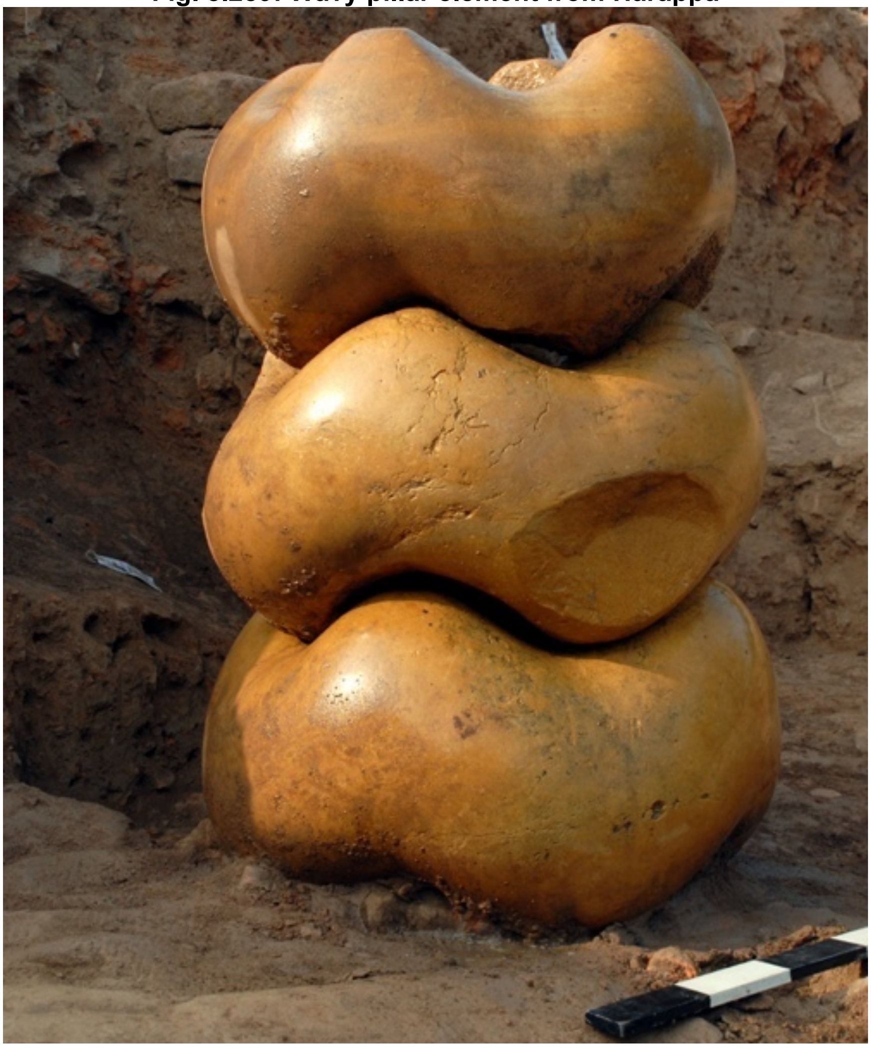
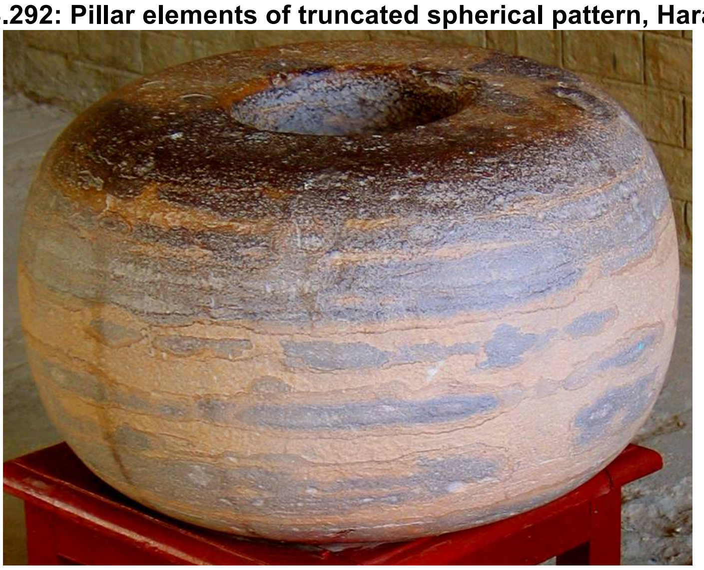


Fig. 8.290: Wavy pillar element fitted one above another, Harappa


Fig. 8.291: Composite pillar element of shell *in situ,* Dholavira


Fig. 8.292: Pillar elements of truncated spherical pattern, Harappa


Fig. 8.293: Pillar element of truncated spherical pattern, Mohenjo-daro

8.9.2.1.8 Doorsills



Fig. 8.294: ***In situ*** **location of door sill in North Gate, Castle**



Fig. 8.295: ***In situ*** **location of door sill in East Gate, Middle Town**



Fig. 8.296: Close up view of door sill, North Gate, Castle

Doorsills are large stone blocks fashioned out of the locally available limestone to serve as a firm grounding at the entrances and near the doors. Often a single rectangular stone block was utilised for this purpose. However, instances of several rectangular blocks were joined / arranged together to produce a large rectangular block as observed at the entrance to the north gate of Castle. Such blocks are observed at the entrances of all major gates. These blocks also have good mechanisms to indicate the locking arrangement of doors. These mechanisms are in the form of deep grooves cut on the top surface , which would have served to intake the vertical wooden lockers, after the doors are fastened.

8.9.2.1.9 Lintels



Fig. 8.297: Location of lintel in North Gate, Castle

Another remarkable piece of architectural member is the remains of lintels that have been found at several places in a secondary context at Dholavira. The typical shape of a lintel is a long slender rectangular block of limestone, which could have been placed above the doorframe. Only one instance of an *in situ* condition of lintel has been unearthed from Dholavira. The

lintel once formed the entrance to the Castle from the north gate after one passes the passageway. The present evidence belongs to Stage V, whose inhabitants largely modified and altered the doorframe of Stage IV, which was nearly 3.5 m in width, reducing it considerably and put another doorframe of loosely arranged stone blocks. Over these stone blocks rests the stone lintel.

8.9.2.1.10 Pivot

Pivots are stone blocks that once served the purpose of holding the pointed edge of door column for easy movement of the door. These pivots have been found in an *in situ* condition at several places, the best among them being the north gate and some of the house blocks.



Fig. 8.298: Example of a pivot

8.9.2.1.11 Door stoppers

Door stoppers are small stone blocks of various shapes and sizes that were used to keep the doors open and preventing them from accidentally closing.

Several such examples of door stoppers have been found from the excavation at Dholavira.


Fig. 8.299: Door stoppers

8.9.2.1.12 Drain Elements

Drain elements are stone blocks, often one long rectangular stone block of limestone that have been scooped on one face to create a channel that can serve as a drain channel. Often two or three such rectangular channel elements were joined together to produce a long drain that emanate from house blocks and important areas of the city. These drain elements were later covered by small flat stones on the top to conceal them.


Fig. 8.300: Stone drain channels


Fig. 8.301: Stone drain channels *in situ*


Fig. 8.302: Stone drain channels *in situ*

8.9.2.2 Free Standing Columns

At least six examples of freestanding columns were discovered from the excavations. These freestanding columns are tall and slender pillars with circular cross-section and with a top resembling a phallus or they are phallic in nature. That is why most of them were found in an intentionally damaged and smashed condition.

The phallus is depicted realistically with even the drawing of foreskin shown clearly. Two of these freestanding columns are found near eastern end of high street of Castle. These columns measure nearly 1.5 m in height and are found at the strategic location of entering into the high street from the east gate of Castle.

These two columns are placed in such a manner at the beginning of high street that is divides the street into three equal parts.



Fig. 8.303: Free standing columns *in situ*

The other freestanding columns of the same variety and typology, numbering into four was found in a completely smashed and broken condition. Two of such columns were found in a secondary condition, fitted as a masonry I subsequent structure. One such column was found embedded in a masonry of Tank A while the other one was found in a masonry in a later period structure near the western fortification of Castle. Two more examples, completely

smashed and destroyed ones were also found, one near the western end of Ceremonial Ground and the second one near the north gate of Castle. The destruction and desecration of these columns can be equated with that of the damage caused to the stone statue, which clearly indicates a change in ideology and traditions, customs after the Harappan phase.



Fig. 8.304: Free standing columns *in situ*

The exact nature of the two free standing columns to the east of high street is also not ascertainable and it is also difficult to determine whether they are in their primary or secondary context.

Interestingly all these stone columns has a roughened and irregularly chipped bottom which is a clear indication of burying them up to the irregular portion so that that polished and highly finished upper portion can remain above the ground.

8.9.3 Stone Statue

The Dholavira statue is perhaps the largest that Harappans ever attempted. It was found placed upside down as a building block of a wall that

was raised by the late Harappans to retain the tilting and bulging northern wall of the passageway of east gate of Castle. It is made of porous limy sandstone with weak matrix. It was in a seating position with a flat base, arms resting on the knees, with both the knees drawn up and kept apart as if to show the genitals as the sculpture has shown no feature of clothing.



Fig. 8.305: Details of free standing columns

The statue depicts a male individual and its execution is close to realistic. The belly is shown protruding. The rear portion of the statue also shows evidence of depiction of hair lots falling down, which is also damaged. It was certainly vandalised, possibly just like all the statutes, which were found in Mohenjo-daro. The genitals were intentionally rubbed off and damaged. A mould was prepared of this statue and a cast was prepared which clearly indicated the closure details of even the genitals. It also clearly indicated the

rubbing off of the genitals intentionally while the other details of genitals were clearly visible. It suggests that it was related to phallus worship, which is nicely corroborated by quite a few finials of pillars with carving in the shape of phallus.



Fig. 8.306: Stone sculpture *in situ*



Fig. 8.307: Details of stone sculpture

The head portion oft his statute is missing now. It seems that its head was intentionally chopped off, elbows and knees are also considerably damaged. The intentional damage caused to this statute may be a clear indication of the paradigm shift in religious belief and ideology, most probably belonging to the mature Harappan phase as this statue is found from a secondary context belonging to Stage VI. The manner in which the statute was damaged clearly indicates that the role played by it could no longer appreciated by Stage VI occupants. The depiction of nicely cut inscriptions on the seals of Stage VI, but without any motif may also indicate a departure of beliefs and customs.

8.9.4 Miscellaneous Stone Objects

8.9.4.1 Games board

At least four games board made of sandstone has been found from the excavations at Dholavira. The largest among them is a complete games board measuring roughly 22 cm X 12 cm. The top surface of the games board is finished and consists of a checker board 12 squares arranged in four rows of three columns each, while an additional two checker is provided from the central column. The top square of these additional two checkers is damaged.



Fig. 8.308: Stone gaming board



Fig. 8.309: Stone gaming board



Fig. 8.310: Stone gaming boards



Fig. 8.311: Stone gaming board with gamesmen

The remaining three games board are also made of sandstone. Out of these, two belong to the same pattern of the first one, even though it is broken and damaged, while the fourth one consists of a different checker pattern. Only a portion of this checker pattern is preserved which indicates two rows of four squares each, on one side and another single column emanating from one end of the above.

8.9.4.2 Stone Bowls

Dish / plate is four in number measuring 20 x 2.5 x cm and 12.3 cm having short vertical flat rim, shallow with flat base prepared out of sand stone. Shallow Stone Dish, (dia 20.5 cm and thickness 3.4 cm). A single example of disc has been found shows medium in size, made of light brownish colour lime stone having convex surface and circular in shape. Roughly prepared with uneven scars in the body.



Fig. 8.312: Stone dishes



Fig. 8.313: Dishes of black coloured stone



Fig. 8.314: Dishes of limestone

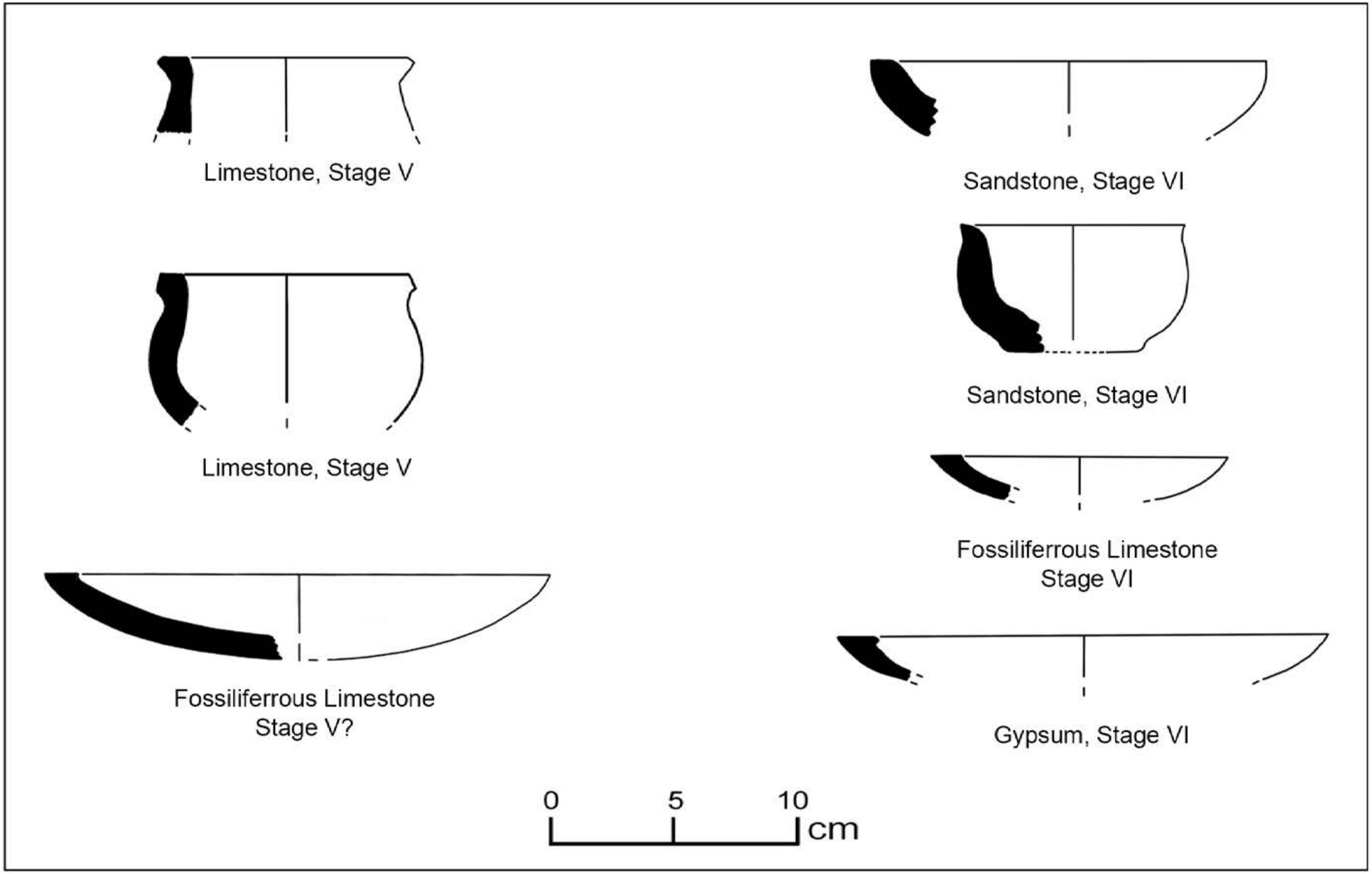


Fig. 8.315: Dishes of brown sandstone and limestone

Few example of people prepared out of fine quartzite of buff colour stone, with squat circular in shape and smooth surface have been found. It may be multipurpose object. A few bowls made of buff colour sand stone, one is partly broken, another fragmentary in nature, both are shallow and small in size having featureless thick rim and rounded base, measuring 15/5 x 5 cm.



Fig. 8.316: Dish of fossileferous limestone



Types of stone vessel forms

Fig. 8.316a: Types of stone vessel forms, Dholavira



Fig. 8.317: Dish of gypsum

8.9.4.3 Stone Vessels

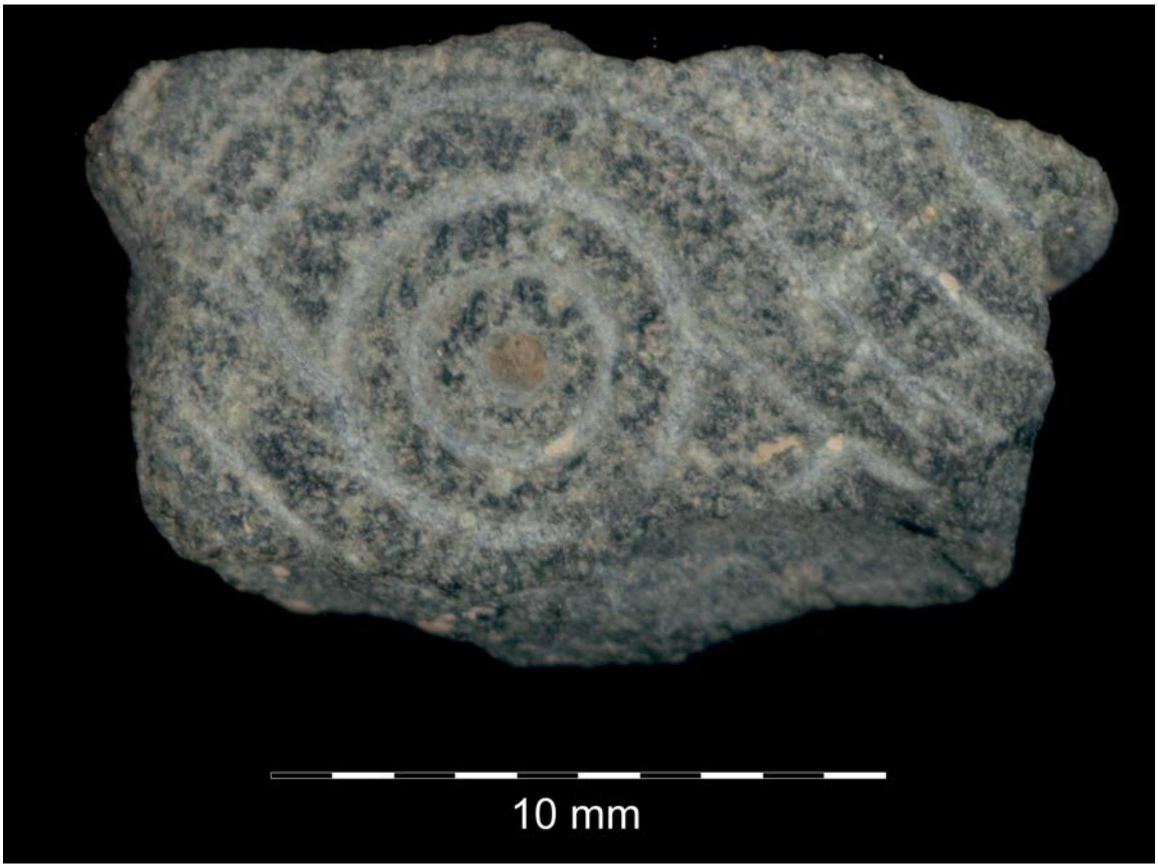


Fig. 8.318: Chlorite stone vessel

Two fragments of the chlorite vessels of the intercultural style have been found from Dholavira. These chlorite vessels are found in a wide area spreading across Mesopotamia, Elam, Central Asia and Indus Civilization. Both these vessels belong to Stage VI, one each from Middle Town and Castle. The first one is a fragment consisting of circles and wavy lines emanating from it. The second one is a broken fragment of a small vessel rectangular in shape, the fourth side on the breadth side is broken.



Fig. 8.319: Details of a chlorite vessel

Each face of the vessel has a decoration of circle with a dot inside a rectangular field.

8.9.4.5 Masonry Blocks

There are examples of innumerable number of stone masonry blocks of various sizes and shapes that were used in the construction of different edifices. Some of the blocks are still *in situ*, the best examples being the structures in Middle Town and South Reservoir 3. The shapes of these masonry blocks include square, rectangle and wedge-shaped. The wedge-shaped blocks is a clear indications of its use in circular structures, most probably wells. These masonry blocs were manufactured with the locally available limestone. The enormous quantity of bedrock removed while construction of a series of reservoirs could have been effectively utilised for manufacturing these blocks.

The South Reservoir 3 preserves some of the well-preserved and manufactured stone masonry blocks, which even resembles baked bricks in terms of its execution.



Fig. 8.320: Details of stone masonry blocks used in South Reservoir 3

A few examples from various places of Dholavira wherein stone masonry blocks are used in the construction is given below:

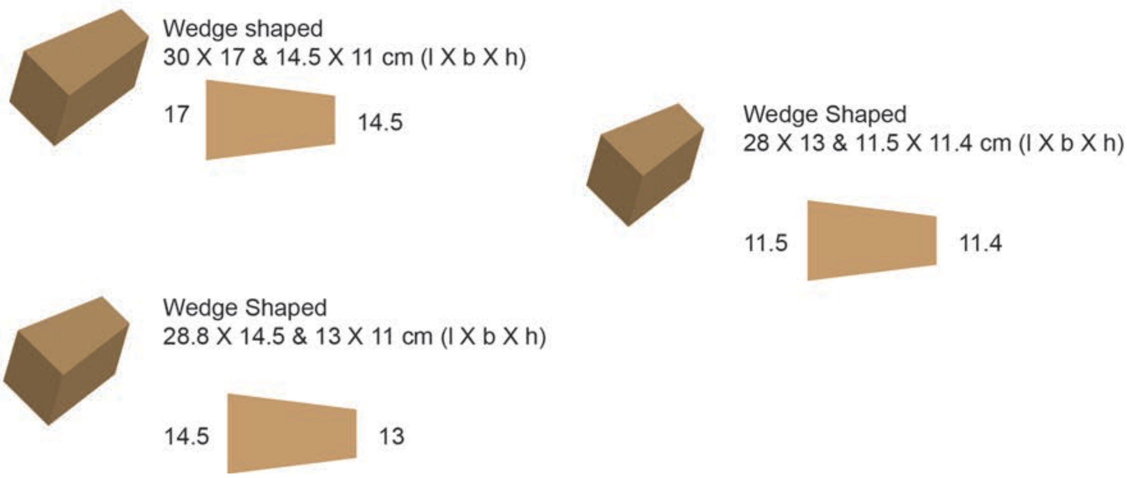


Fig. 8.321: Measurements of wedge shaped stone blocks

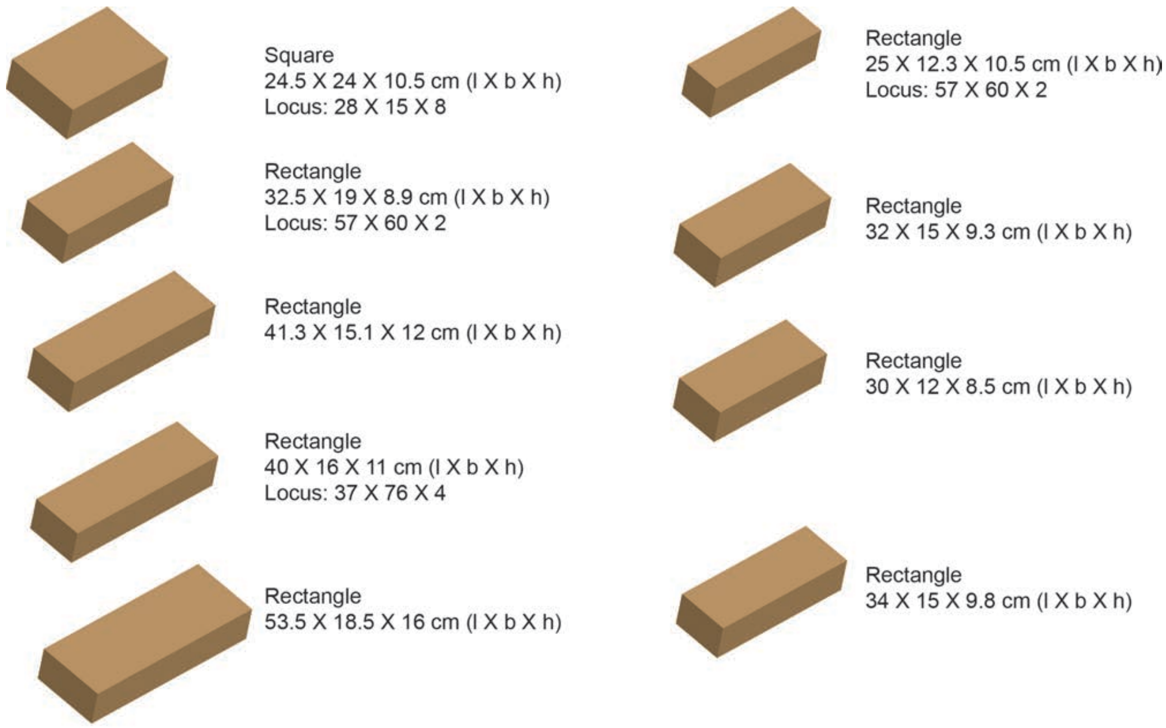


Fig. 8.322: Measurements of various stone blocks



Fig. 8.323: Stone masonry blocks

8.10.1 Miscellaneous Terracotta Objects

8.10.1.1 Gaming Objects

Large number of gaming objects was reported from the site Dholavira. These gaming objects made out of variety of materials like bone, ivory, terracotta and stone. Both outdoor and indoor gaming objects were made by the people. Terracotta gaming artifacts remains the favorite material for common people that is why we get large number of terracotta gaming objects as compare to other material.

8.10.1.2 Sling Balls

Apart from terracotta figurines, toy cart frames and wheels other terracotta made objects were reported from the site, among them more than five hundred sling balls was reported from excavation. Most of them were plain in appearance but few individual examples shows decoration with nail incision. There most probable use must be for playing, but according to S.R.Rao who thinks that there is a possibility of using these balls for keeping records as happens in the city of Uruk.

8.10.1.3 Hopscotches

Hopscotches were another popular play object of children. In Dholavira approximately four hundred hopscotches reported from the site. Prominently they are made up from potsherds but there are few pieces who were moulded ones. It is observed that seven examples were made-up of painted potsherds.

8.10.1.4 Rattles

Rattles are loved by the infants or kids below the age of five. Total eight Rattles were found, among them four were in fully preserved condition, and rest is in fragmentary condition. Two of them were found painted with white pigment over red surface. Being hollow from inside it is observed that they were made by wrapping the clay in round shape and putting inside some small clay pellets for creating sound.



Fig. 8.324: Ladles, Terracotta

8.10.1.5 Gamesmen

Play objects of elders were also get due attention by Dholavirans, among it gamesmen, dices and game board is prominent. More than hundred gamesmen were found from Dholavira. They are basically of three types: castle, pellets and cones. All are plain but few individual examples are found painted with brown pigment having horizontal lines. One noticeable thing that is there is a complete absence of zoomorphic style of terracotta gamesmen in the assemblage. Castle type which outnumbered the other varieties were probably denomination of king, minister etc. The pellets style one were having two sub type – circular one and triangular one which were having round edges and sometimes shows finger impression, but there are also examples of sharp edged triangular gamesmen they are most probable denomination must be of soldiers. The third variety is of cones, they made like small conical objects.

8.10.1.6 Dices

Along with gamesmen and game board dices also forms the important play object. As far as dices is concerned three terracotta cubical dices apart from one cubical stone dice in various degree of preservation reported from the site.

-47x85x1: slightly broken having grooving six opposite five, two opposite one and three opposite four. Probably belongs to stage VI

-47x46: only half portion is preserved shows only one side grooving (four) probably belongs to stage V

-46x71x1: halfway broken shows grooving three opposite five four opposite two and one opposite probably six. Probably belongs to stage V

8.10.1.7 Cones

Large numbers of cones were found from the site; however, its probable use is quite hard to understand but various excavators and scholars that either it is used for playing or votive offering. There is an instance that, in Sumerian civilization these types of cone largely used to decorate the walls.

8.10.2 Household artefacts

There are various terracotta materials which were used as household things. These included terracotta ladles, inlays, tiles, button, smoking pipe and skin rubber.

8.10.2.1 Terracotta ladle

There are three terracotta ladles found from the site. One is comparatively small in size but in fully preserved condition reported from middle town and probably belongs to stage IV. It is bright red in appearance having deep bowl and round section handle along with shoot marks or black colour trace on mouth area. The second piece reported from citadel were having channel shaped handle and broken offering pot seems to be quite shallow, probably belongs to stage IV. The third piece is again found from the citadel area having broken handle area and probably belongs to stage VI. These types of ladles were extensively used for the purpose of ritualistic offerings and causes black shoot marks on the mouth part of ladle. However these are usually used for pouring liquid.

8.10.2.2 Terracotta inlay pieces

Very less amount of terracotta inlay pieces were found from the upper town and middle town of the site and belongs from stage V to VI. Most of them are of almond shape with few exceptions.

8.10.2.3 Terracotta tiles

Like inlay pieces these are also found in very limited number and fragmentary condition. There is a one piece from the debris of 58x33x3 trench at the depth of 2.45cm shows engraved decoration in floral pattern.



Fig. 8.325: Tile, Terracotta

8.10.2.4 Button

A single half broken terracotta button is found from the site having two minute perforation along with. It is found in the area 24x5x1 at the depth of +42cm from stratum 2.

8.10.2.5 Smoking pipe

One smoking pipe is found in area of southern reservoir (48x67) at the depth of 2.00 cm from stratum 5. The pipe is half way broken but having shoot marks at the mouth area.

8.10.3 Personal ornaments

Ornaments in terracotta were usually used by the common masses. This category included pendants, bangles, anklets, ear studs, spacer, rings and

beads. Among them bangles outnumbered the other ornaments as they found in large quantity.

8.10.3.1 Pendants

Pendants made in terracotta were found in considerable amount. They are either having perforations or engraving at top to tie the thread; usually perforated ones are less in number as compare to engrave one. Total eighteen in number these pendants are in various shapes conical, castle type gamesmen etc. it seems that people transform the earlier used gamesmen into pendant at later stage because most of the pendants are from stage V. So it might be possible that gamesmen of stage IV or earlier period were intentionally modified into pendants in stage V.

8.10.3.2 Bangles

There is large number of bangles fragments made of terracotta. Most of them were plain with very few ones are painted. There is also some kind of incised decoration noticed on them.



Fig. 8.326: Bangles, Terracotta

8.10.3.3 Beads

Large number of terracotta beads was found from the site having different shapes.



Fig. 8.327: Beads, Terracotta

8.10.3.4 Spacer

Spacers were generally used in the necklaces along with beads having thin rectangular in shape with perforation in Between. Consider number of spacer either in fragmentary condition or in fully preserved condition was found from the site.



Fig. 8.328: Beads and spacer bead, Terracotta

8.10.4 Tools

Various terracotta made tools were in use among the Dholavirans as indicated by the occurrence of these kinds of materials in the assemblage like terracotta plumb bob, points, scraper, celts, net sinker, crucibles, weights and spacer.

8.10.4.1 Plumb bob

Plumb bob were used by the masons to check the perpendicularity of the structure. Dholavira posses only single terracotta plumb bob apart from a stone one. The terracotta plumb bob is conical in shape with slightly broken top and having perforation along the bottom. It is found from the middle town (35x73x4) and probably belongs to stage V.

8.10.4.2 Celt

Only two piece of terracotta celt was found from the site. Both are look like a replica of stone celts having broad and sharp working edge which narrower and thick at the top forming a rough triangle. These are found from the lower town area (24x10x3, 24x6x2) and probably belong to stage V.

8.10.4.3 Chisel

Chisel made of terracotta is very hard to work that is why in the Dholavira it is found in limited number. Infect only two pieces were found from 58x52x4 and 54x58x2&3. One is round and cylindrical in shape with flat sharp working edge while another is flat rectangular in shape with sharp working edge.

8.10.4.4 Crucible and mould

Some crucibles and moulds were found from the site, though quite limited in number. Shape of only one piece is identifiable that is reported to be found from rain gully area of castle (58x3x4) from stratum 7A at the depth of approximately 10.90 to 10.92cm which indicate that it is most probably of stage I. The shape of this crucible is in channel or boat shape. The shape of other crucible is hard to identify however all of them were having traces of copper along with shoot marks.

8.10.4.5 Points

Consider number of terracotta conical objects with sharp point was discovered from the site often called as point, cone or engraver. They are basically of three varieties. First category is having slightly thick cylindrical shape having round section getting narrow and pointed at the tip. Second category is almost same except being cylindrical and round it is flat and rectangular at one end while pointed and round at another end. The third variety contains pieces having thin round section cylindrical structure and slightly narrower tip.

8.11 Stoneware Bangles

The stoneware bangles found from several Harappan sites ever since the first excavations at Harappa and Mohenjo-daro are extremely rare and important due to their "unique technological features and micro-inscriptions" (Blackman & Vidale: 1989). Blackman & Vidale (1989) describes "stoneware" as *"…..highly siliceous partly sintered, homogenous ceramic body usually free from inclusions or voids visible to the naked eye, and characterized by very low porosity".* The stoneware bangles were *"…produced in two basic varieties – one fired in a strongly reduced atmosphere, assuming colours ranging from pinkish-grey to black, and others from reddish shadows resulting from partial re-oxidation"* (Blackman & Vidale: 1989). Halim and Vidale (1987) describes in detail on the mechanism involved in the production of these stoneware bangles based on the evidence obtained from surface reconnaissance from Mohenjo-daro. The remains from Mohenjo-daro consisted of slags, kiln wasters and a sophisticated double container system (Halim and Vidale: 1987).

The chemical analysis of nearly 60 samples from stoneware bangles and terracotta saggers from Harappa and Mohenjo-daro by Blackman and Vidale (1989) indicated two distinct chemical compositional groups. The chemical analysis also enabled to conclude the stoneware bangles were being manufactured separately at Harappa as well as Mohenjo-daro. Even though Black and Vidale (1989) points out the very small number of samples, they conclude based on the analysis that *"……production/distribution picture that indicates production at both sides, but with a unidirectional distribution system from Mohenjo-daro to Harappa".*

The stoneware bangles are often represented by very few numbers from excavations and found mostly during the mature Harappan phase. The picture from Dholavira is also not different and only 108 fragments could be found from the artefact collection, out of which 17 seems to be terracotta rings that formed support or base of the containers in which the stoneware bangles were baked. The Dholavira collection of stoneware bangles contains a range of colours, from light grey to black, and various shades of reddish orange, indicating their

manufacture both under reduced atmospheric conditions as well as partial re-oxidation.

As mentioned above a total of 108 examples were available for analysis to find out the nature of object and it has been observed that out of these, 17 are terracotta rings or bases for the containers and 91 are fragments of stoneware bangles. This constitutes 84.3% stoneware bangles and 15.7% terracotta rings.

Object

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bangle	91	84.3	84.3	84.3
	TC ring	17	15.7	15.7	100.0
	Total	108	100.0	100.0	

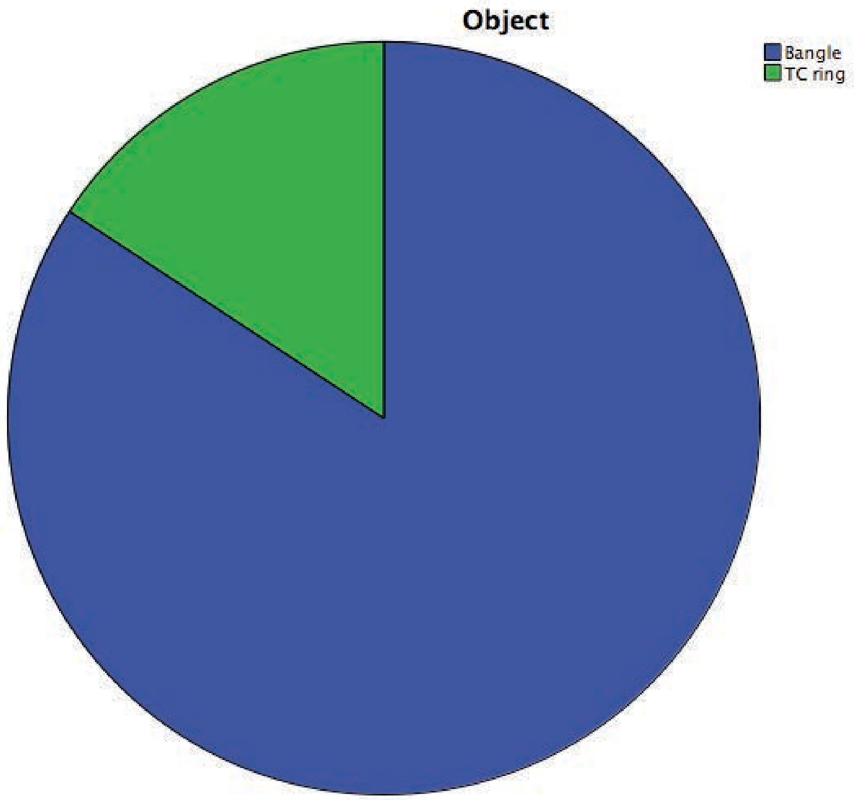


Fig. 8.329: Pie chart showing the percentages of terracotta ring and stoneware bangles

A total of 57 examples were available for understanding its distribution in various periods and out of these 17 (29.8%) falls in Stage IV, while 27 (47.4%) in Stage V and 13 (22.8%) in Stage VI. The large percentage, i.e. almost 77.2% of

the evidence from mature Harappan phase indicates the preference of these bangles or knowledge of production of such extremely sophisticated items.

Period

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	IV	17	29.8	29.8	29.8
	V	27	47.4	47.4	77.2
	VI	13	22.8	22.8	100.0
	Total	57	100.0	100.0	

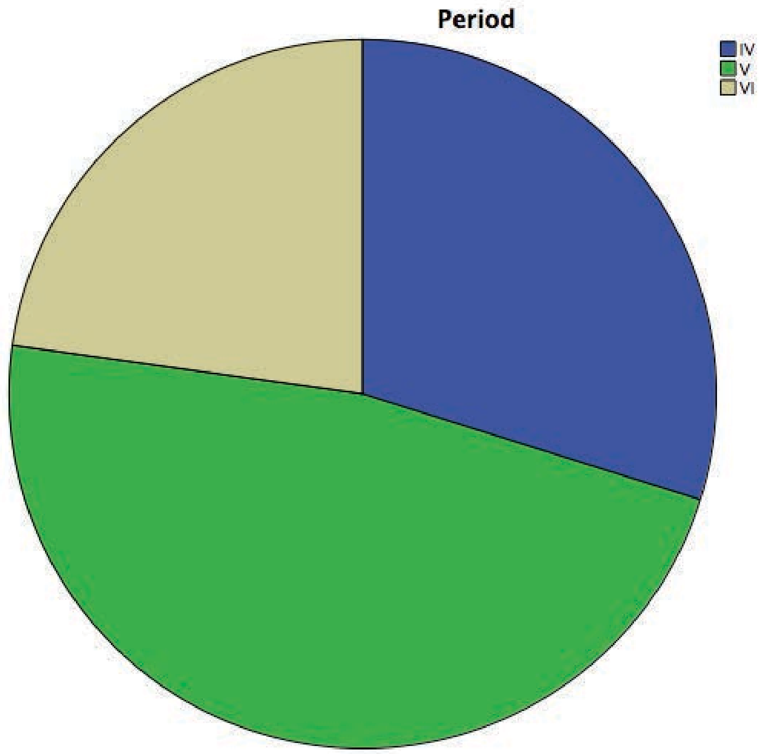


Fig. 8.330: Pie chart showing the percentages of period-wise distribution of stoneware bangles

A total of 105 examples were analysed to know the locality of their finds and it indicates that it is more or less evenly spread out in all the places of city. However, certain localities like stadium, reservoir, and outside the habitational areas, can be of secondary context. The percentage-wise analysis of habitation areas indicates that the specimens are present mostly from Citadel (17, 16.2%), Bailey (15, 14.3%), Lower Town (15, 14.3%) and Middle Town (10, 9.5%). The combined areas of Bailey and Citadel (32, 20.5%) indicate the importance of these specimen.

Locality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bailey	15	14.3	14.3	14.3
	Citadel	17	16.2	16.2	30.5
	Eastern Reservoir	5	4.8	4.8	35.2
	Lower Town	15	14.3	14.3	49.5
	Middle Town	10	9.5	9.5	59.0
	Small Stadium	22	21.0	21.0	80.0
	Southern Reservoir	19	18.1	18.1	98.1
	Stadium	1	1.0	1.0	99.0
	SW corner of city	1	1.0	1.0	100.0
	Total	105	100.0	100.0	

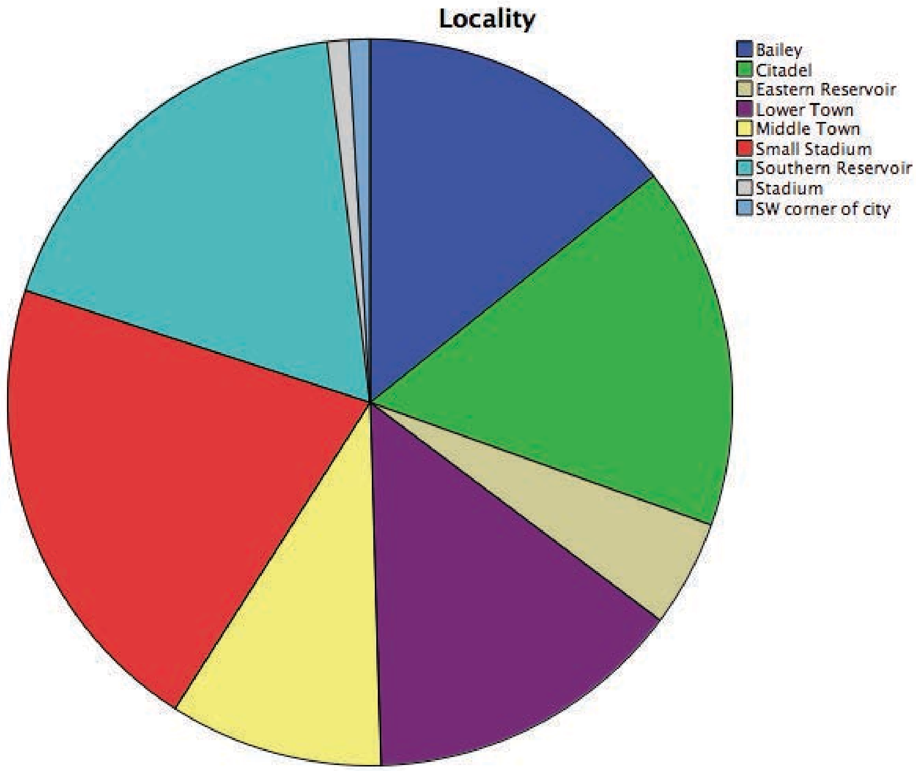


Fig. 8.331: Pie chart showing the percentages of locality of stoneware bangles

The samples were measured for dimensions like internal and external diameter to understand the range of size of bangles. A total of 95 samples were

available for measuring internal diameter and it indicates that 49 samples are with 5 cm diameter (51.6%) followed by 6 cm (24, 25.3%), 4 cm (10, 10.5%). Only one specimen was with 10 cm diameter.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	1	1.1	1.1	1.1
	2	1	1.1	1.1	2.1
	3	1	1.1	1.1	3.2
	4	10	10.5	10.5	13.7
	4.5	1	1.1	1.1	14.7
	5	49	51.6	51.6	66.3
	5.5	5	5.3	5.3	71.6
	6	24	25.3	25.3	96.8
	7	3	3.2	3.2	100.0
	Total	95	100.0	100.0	

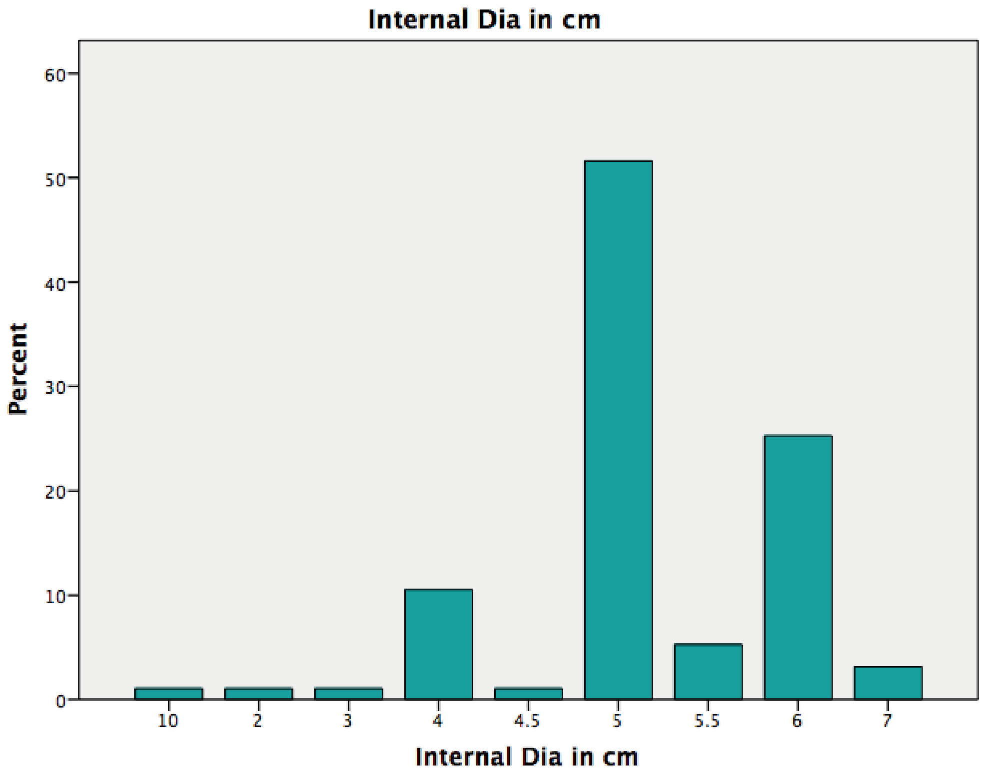


Fig. 8.332: Pie chart showing the percentages of internal diameter of stoneware bangles

A total of 97 specimens were available for measurement of external diameter and the analysis indicates that an overwhelming 37 specimen with 8 cm

as diameter (38.1%), followed by 7 cm (17, 17.5%), 8.5 cm (13, 13.4%), 7.5 and 9 cm (8 specimen each, 8.2%).

External Dia in cm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	1	1.0	1.0	1.0
	13	1	1.0	1.0	2.1
	6	3	3.1	3.1	5.2
	6.5	4	4.1	4.1	9.3
	7	17	17.5	17.5	26.8
	7.5	8	8.2	8.2	35.1
	8	37	38.1	38.1	73.2
	8.1	1	1.0	1.0	74.2
	8.4	2	2.1	2.1	76.3
	8.5	13	13.4	13.4	89.7
	9	8	8.2	8.2	97.9
	9.5	2	2.1	2.1	100.0
	Total	97	100.0	100.0	

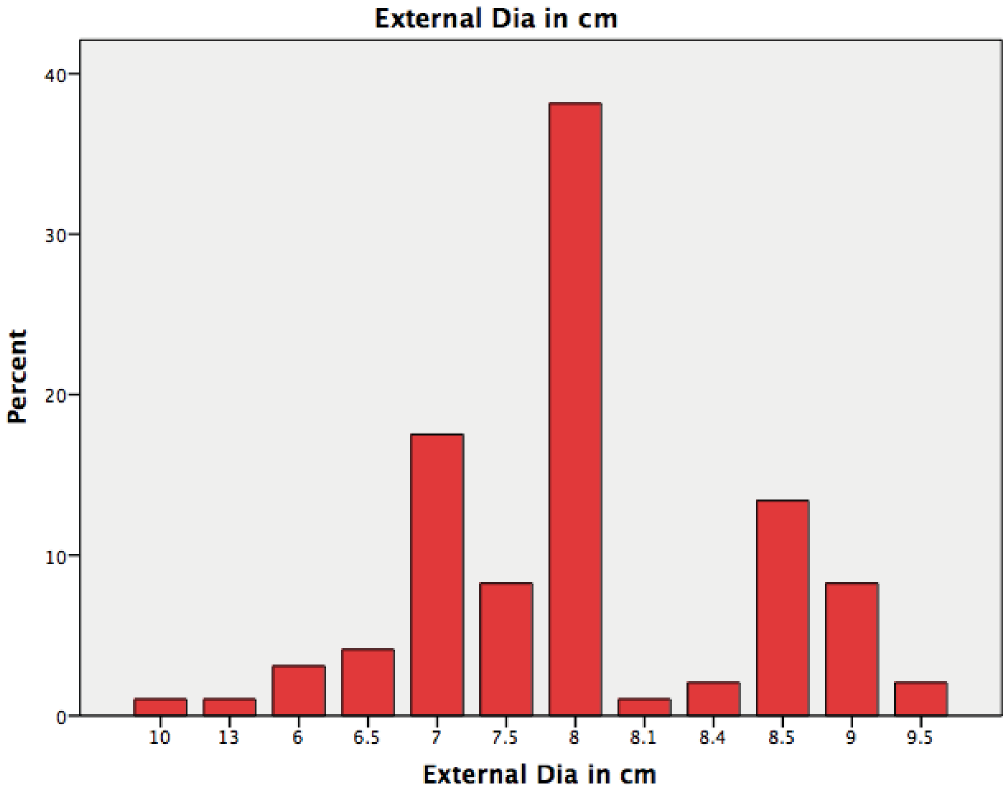


Fig. 8.333: Pie chart showing the percentages of external diameter of stoneware bangles



Fig. 8.334: Examples of stoneware bangles from Dholavira



Fig. 8.335: Examples of stoneware bangles from Dholavira



Fig. 8.336: Examples of stoneware bangles of grey to black colours from Dholavira


Fig. 8.337: Examples of stoneware bangles of grey to black colours from Dholavira



Fig. 8.338: Examples of stoneware bangles of grey to black colours from Dholavira



Fig. 8.339: Examples of stoneware bangles of reddish orange colours from Dholavira



Fig. 8.340: Examples of stoneware bangles of reddish orange colours from Dholavira



Fig. 8.341: Examples of terracotta rings from Dholavira

LIST OF STONEWARE BANGLES AND TC RINGS FROM DHOLAVIRA EXCAVATION

Acc.No.	Trench	Layer	Depth	Object	Period	Locality	Int. Dia in cm	Ext. Dia in cm	Max Width in mm	Min Width in mm	Average in mm	Max Thick in mm	Min Thick in mm	Average in mm
6465	57 X 5 X 2	1	-25 to -30	Bangle	VI	Bailey	7	9	16.11	15.74	15.925	13.32	12.36	12.84
69	58 X 51 X 1	Dump 1 s.b. 3	-110	Bangle	V	Bailey	-	-	-	-		12.65	12.23	12.44
26692	58 X 18 X 4	6	-255	Bangle	IV	Bailey	5.5	8.5	15.70	15.32	15.51	13.26	12.86	13.06
12351	57 X 38 X 3	4	-300	Bangle	IV	Bailey	6	8	16.20	16.03	16.115	13.84	13.40	13.62
19522	58 X 55 X 4	3	-117	Bangle	V	Bailey	6	8.5	12.45	12.42	12.435	12.98	12.90	12.94
24758	57 X 47 X 3 & 57 X 57 X 2	26 to 29	-371 to -458	Bangle	IV	Bailey	6	8	16.11	16.02	16.065	11.55	11.44	11.495
18853	57 X 53 X 2	1	-8	Bangle	VI	Bailey	4	7	16.45	16.37	16.41	13.37	13.28	13.325
11824	57 X 17 X 1	4	-174	Bangle	V	Bailey	5	7	14.50	14.46	14.48	12.86	12.67	12.765
18761	57 X 57 X 2	2	-107	Bangle	V	Bailey	6	8	14.78	14.24	14.51	13.61	13.55	13.58
18734	57 X 60 X 1	1D	-58	Bangle	VI	Bailey	6	8	16.49	16.30	16.395	12.76	12.70	12.73
24629	57 X 7 X 3	1 to 3	-58 to -133	Bangle	V	Bailey	-	-	-	-		-	-	
18750	58 X 51 X 1	2	-40	Bangle	VI	Bailey	5.5	8	15.85	15.28	15.565	13.48	13.22	13.35
20731	57 X 67 X 2	6	-257	Bangle	IV	Bailey	6	8	15.43	15.07	15.25	15.23	15.10	15.165
1807	XK 19 X 2	3	-50	Bangle	VI	Bailey	5.5	8.5	16.05	15.84	15.945	12.95	12.88	12.915
18752	57 X 56 X 1	2	-30	TC ring	VI	Bailey	6	8	16.33	15.89	16.11	17.32	16.88	17.1
16150	47 X 88 X 4	4A	-186	Bangle	V	Citadel	4	7	18.08	17.94	18.01	11.82	11.76	11.79
Temp 004	47 X 67 X 2	4	-90	Bangle	VI	Citadel	-	-	-	-	-	-	-	-
8741	47 X 53 X 1&2	7	-70 to -94	Bangle	VI	Citadel	5	7	15.78	15.22	15.5	15.48	15.37	15.425
8662	47 X 61 X 1&2	8A	-420	Bangle	IV	Citadel	2	7	17.70	16.73	17.215	14.74	14.48	14.61

Acc.No.	Trench	Layer	Depth	Object	Period	Locality	Int. Dia in cm	Ext. Dia in cm	Max Width in mm	Min Width in mm	Average in mm	Max Thick in mm	Min Thick in mm	Average in mm
3856	47 X 80 X 2	1	-15 to -35	Bangle	VI	Citadel	5	7.5	14.42	14.30	14.36	12.73	12.59	12.66
2484-2005	47 X 74 X 4	18	-370	Bangle	IV	Citadel	5.5	8.5	17.74	17.64	17.69	13.08	12.92	13
2800A	XE22 Qd 1	16	-175 to -235	Bangle	IV	Citadel	4	7	16.18	16.05	16.115	14.63	14.50	14.565
2800B	XE22 Qd 1	16	-175 to -235	Bangle	IV	Citadel	4	7	16.40	16.28	16.34	14.16	14.09	14.125
5051	48 X 72	5	-42 to -47	Bangle	VI	Citadel	4	6	17.09	17.01	17.05	11.79	11.56	11.675
6250	47 x 9 x 2	5	-70	Bangle	VI	Citadel	5	7	16.05	15.98	16.015	14.80	13.91	14.355
11131	47 X 6 X 2	1	-34	Bangle	VI	Citadel	5	7	16.60	15.98	16.29	13.58	13.47	13.525
6410	47 X 8 X 3	2	-12A	Bangle	V	Citadel	4	6.5	16.99	16.94	16.965	12.72	12.70	12.71
2318-2005	47 X 84 X 1	14	-470	TC ring	IV	Citadel	5	8.5	18.78	18.69	18.735	16.19	15.94	16.065
1355(2005)	47 X 73 X 3	28	-580	TC ring	IV	Citadel	6	8.5	17.71	17.09	17.4	17.54	17.07	17.305
2382(200)	47 X 67 X 3	6	-315	TC ring	IV	Citadel	4	6.5	17.43	17.1	17.265	17.86	17.29	17.575
2117A-2000	37 X 55 X 2&3	9	-375	Bangle		Eastern Reservoir	5	8	14.21	13.99	14.1	14.37	13.56	13.965
2117A-2000	37 X 55 X 2&3	9	-375	Bangle		Eastern Reservoir	6	9	15.28	15.16	15.22	13.35	13.25	13.3
1941-2000	37 X 55 X 2&3	16	-720	Bangle		Eastern Reservoir	6	9.5	-	-	-	-	-	-
1454B-2000	37 X 55 X 2&3	15	-630	Bangle		Eastern Reservoir	-	-	17.19	17.12	17.155	14.43	14.36	14.395
25127	37 X 75 X 1			Bangle		Eastern Reservoir	5	8	15.79	15.66	15.725	12.86	12.72	12.79
24418	25 X 9 X 3	1	-85	Bangle	V	Lower Town	-	8	-	-		13.36	12.28	12.82
22721	25 X 7 X 3	3	-109	Bangle	IV	Lower Town	6	8	15.98	15.48	15.73	14.90	14.81	14.855
23340	25 X 5 X 3	7	-99	Bangle	V	Lower Town	6	8	16.17	16.58	16.375	14.20	13.90	14.05
22292	25 X 5 X 4	3	-52	Bangle	V	Lower Town	5	7	16.67	16.49	16.58	14.02	13.97	13.995
23192	25 X 5 X 3	6	-83	Bangle	V	Lower Town	4	6	12.56	12.16	12.36	10.69	10.35	10.52

Acc.No.	Trench	Layer	Depth	Object	Period	Locality	Int. Dia in cm	Ext. Dia in cm	Max Width in mm	Min Width in mm	Average in mm	Max Thick in mm	Min Thick in mm	Averag e in mm
22170	15 X 16	surface		Bangle	V	Lower Town	5	7	16.05	16.19	16.12	13.37	13.34	13.355
22024	Lower Town	surface		Bangle	V	Lower Town	6	8	16.70	16.54	16.62	12.26	12.10	12.18
13646	15 X 74 X 3	1A	-27	Bangle	V	Lower Town	5	7	15.63	15.57	15.6	13.91	13.79	13.85
24357	25 X 10 X 1	2	-56 to -60	Bangle	V	Lower Town	5	7	15.85	15.11	15.48	14.19	13.94	14.065
19459	5 X 73 X 3	4A	-114	Bangle	IV	Lower Town	5	8	15.53	15.28	15.405	16.35	16.32	16.335
1180-2005	7 X 58 X 2	11	-470	TC ring	IV	Lower Town	5	8.5	19.58	18.55	19.065	19.79	19.23	19.51
Temp 002	25 X 2 X 4	2	-38	TC ring	V	Lower Town	7	9	16.52	16.19	16.355	16.98	16.65	16.815
23021	25 X 5 X 3	4	-68	TC ring	V	Lower Town	5	10	27.24	26.02	26.63	16.17	16.03	16.1
25646	surface	surface		TC ring	V	Lower Town	3	6	16.67	16.12	16.395	16.3	16.09	16.195
16	15 X 84 X 1	3	-335	TC ring	IV	Lower Town	4	9	26.78	25.08	25.93	18.86	18.19	18.525
17092	56 X 51 X 2	12	-391	Bangle	IV	Middle Town	6	7.5	12.81	12.65	12.73	12.73	12.51	12.62
1653-2000	66 X 55 X 1	3	-96	Bangle	V	Middle Town	5	7	16.15	15.87	16.01	11.53	11.29	11.41
2219-2000	66 X 55 X 1	pit 2 s.b. 9	-174	Bangle	IV	Middle Town	5	7.5	13.19	13.05	13.12	13.48	13.97	13.725
19630	54 X 58 X 1	3A	-58	Bangle	V	Middle Town	5	7.5	18.38	18.10	18.24	15.00	14.52	14.76
15264	35 X 53 X 1	1	-65	Bangle	V	Middle Town	6	8.5	16.09	16.03	16.06	12.70	12.69	12.695
1060-2003	55 X 36 X 1	2	-26	Bangle	V	Middle Town	-	8	-	-		-	-	
5396A-2003	55 X 78	2	-15	Bangle	V	Middle Town	-	-	15.11	15.25	15.18	15.65	15.55	15.6
5396B-2003	55 X 78	2	-15	Bangle	V	Middle Town	-	-	15.45	15.13	15.29	15.84	15.62	15.73

Acc.No.	Trench	Layer	Depth	Object	Period	Locality	Int. Dia in cm	Ext. Dia in cm	Max Width in mm	Min Width in mm	Average in mm	Max Thick in mm	Min Thick in mm	Average in mm
2211	ZA 14 X 2	3	-35	Bangle	V	Middle Town	5	8	15.96	15.74	15.85	12.48	12.79	12.635
478-2005	55 X 85 x 3	2	-47	Bangle	V	Middle Town	-	-	16.58	16.26	16.42	18.68	18.4	18.54
3003-2000	37 X 44 X 2&3	2	-65	Bangle		Small Stadium	5	8.2	-	-	-	-	-	-
1538-2000	37 X 44 X 3	2	-50	Bangle		Small Stadium	4.5	8	17.34	17.24	17.29	14.18	13.87	14.025
23209A	37 X 34 X 3		-130 to -142	Bangle		Small Stadium	5	8.4	17.33	17.08	17.205	15.04	14.37	14.705
23209B	37 X 34 X 3		-130 to -142	Bangle		Small Stadium	6	8.4	13.84	13.46	13.65	15.04	14.3	14.67
24427	37 X 34 X 3	7	-263 to -275	Bangle		Small Stadium	6	9.5	17.71	17.63	17.67	14.92	14.85	14.885
2950E-2000	37 X 44 X 2	2	-30 to -60	Bangle		Small Stadium	6	8.5	14.74	14.37	14.555	15.82	13.89	14.855
2950B-2000	37 X 44 X 2	2	-30 to -60	Bangle		Small Stadium	5	7	17.72	17.42	17.57	15.76	15.31	15.535
2950F-2000	37 X 44 X 2	2	-30 to -60	Bangle		Small Stadium	5	7.5	13.82	13.36	13.59	15.17	13.99	14.58
154	37 X 55 X 2&3	15	-630	Bangle		Small Stadium	5	8	17.08	16.79	16.935	16.77	16.36	16.565
Temp 003	37 X 34 X 3	4A	-170	Bangle		Small Stadium	5	8	16.82	16.61	16.715	15.92	15.15	15.535
2665-2000	37 X 44 X 2	2	-20	Bangle		Small Stadium	5	8	16.31	16.21	16.26	15.27	15.21	15.24
100-2000	37 X 44 X 1-4	7	-105	Bangle		Small Stadium	5	8	16.18	15.86	16.02	14.31	13.89	14.1
21666	37 X 34 X 3	4	-154	Bangle		Small Stadium	5	8.5	16.71	16.52	16.615	15.72	15.68	15.7
936-2000	37 X 55 X 2	12	-630	Bangle		Small Stadium	5	8	16.74	16.58	16.66	12.64	12.44	12.54
180-2000	37 X 55 X 2&3	16	-850	Bangle		Small Stadium	6	9	16.72	16.42	16.57	14.21	13.92	14.065
2950D-2000	37 X 44 X 2	2	-30 to -60	Bangle		Small Stadium	5	7.5	13.91	13.49	13.7	15.04	14.89	14.965

Acc.No.	Trench	Layer	Depth	Object	Period	Locality	Int. Dia in cm	Ext. Dia in cm	Max Width in mm	Min Width in mm	Average in mm	Max Thick in mm	Min Thick in mm	Average in mm
1454C-2000	37 X 55 X 2&3	15	-630	Bangle		Small Stadium	5	8.5	18.86	18.71	18.785	15.41	15.38	15.395
26266	37 X 45 X 1	3	-30	Bangle		Small Stadium	5	8	15.89	15.79	15.84	12.82	12.72	12.77
2950C-2000	37 X 44 X 2	2	-30 to -60	Bangle		Small Stadium	-	-	-	-	-	-	-	-
Temp 001	37 X 34 X 3	3	-137	Bangle		Small Stadium	5	7.5	17.31	16.7	17.005	17.34	15.54	16.44
2770(2000)A	37 X 44 X 2	2	-40	TC ring		Small Stadium	5.5	8	16.68	15.37	16.025	17.76	17.11	17.435
2770(2000)B	37 X 44 X 2	2	-40	Bangle		Small Stadium	5	7	15.01	14.91	14.96	15.51	15.28	15.395
5155	48 X 92 X 1&2	24	-305 to -335	Bangle		Southern Reservoir	5	8	16.80	16.64	16.72	15.12	14.80	14.96
26908A	48 X 39 3&4	7	-670	Bangle		Southern Reservoir	6	9	16.52	15.96	16.24	14.05	13.75	13.9
26908B	48 X 39 3&4	7	-670	Bangle		Southern Reservoir	5	8	15.08	14.71	14.895	14.33	13.05	13.69
5107A	48 X 72	5	-42 to -47	Bangle		Southern Reservoir	6	9	16.88	16.48	16.68	12.62	12.58	12.6
5107B	48 X 72	5	-42 to -47	Bangle		Southern Reservoir	5	8	17.12	16.95	17.035	12.55	12.41	12.48
7440	48 X 82 X 3	10	-200	Bangle		Southern Reservoir	-	-	-	-	-	-	-	-
24889	47 X 88 X 2&3	section		Bangle		Southern Reservoir	6	8	12.75	12.63	12.69	13.99	13.56	13.775
24256	59 X 11 X 1	dump 1	+43 to +13	Bangle		Southern Reservoir	5	8	15.72	15.66	15.69	13.87	13.8	13.835
6243	48 X 94 X 4	16K	-508 to -521	Bangle		Southern Reservoir	5	8	15.59	15.44	15.515	12.73	12.64	12.685
6269	48 X 94 X 4	19	-561 to -571	Bangle		Southern Reservoir	5	7.5	14.58	13.59	14.085	13.8	13.66	13.73
4497-2004	38 X 93 X 2	3	-58	TC ring		Southern Reservoir	5	8	14.58	14.32	14.45	14.98	12.32	13.65
6185	48 X 94 X 4	12		Bangle		Southern Reservoir	5	8	16.43	16.42	16.425	13.53	13.37	13.45

Acc.No.	Trench	Layer	Depth	Object	Period	Locality	Int. Dia in cm	Ext. Dia in cm	Max Width in mm	Min Width in mm	Average in mm	Max Thick in mm	Min Thick in mm	Average in mm
12(2005)	58 X 39 X 3	5	-140	TC ring		Southern Reservoir	10	13	21.32	20.64	20.98	16.42	16.38	16.4
6022(2000)A	48 X 38 X 1&2	17	-780	Bangle		Southern Reservoir	6	8	17.06	16.57	16.815	14.54	14.28	14.41
6022(2000)B	48 X 38 X 1&2	17	-780	TC ring		Southern Reservoir	6	8.5	19.15	18.67	18.91	16.41	16.38	16.395
4473(2004)	48 X 88	7	-205	TC ring		Southern Reservoir	7	9	16.16	14.69	15.425	15.95	14.59	15.27
4489(2004)A	48 X 19 X 1	2	-20	TC ring		Southern Reservoir	5	7	17.24	16.04	16.64	18.82	17.62	18.22
4489(2004)B	48 X 19 X 1	2	-20	TC ring		Southern Reservoir	5	6.5	13.37	12.41	12.89	13.88	13.18	13.53
5040(2000)	38 X 31 X 1	7	-280	Bangle		Southern Reservoir	5	8	17.81	17.5	17.655	13.53	12.82	13.175
1993-2005	47 X 61 X 4	5	-320	TC ring		Stadium	4	6.5	18.92	17.87	18.395	17.32	16.79	17.055
5743	79 X 94 X 2&3	7	-115	Bangle		SW corner of city	-	-	-	-	-	-	-	-
48A	Zone 1			Bangle			5	8	16.38	16.2	16.29	14.75	14.55	14.65
48B	Zone 1			Bangle			5	8	17.38	16.77	17.075	15.26	15.12	15.19
553	Zone 2	surface		Bangle			5	8.5	16.97	16.68	16.825	12.35	12.33	12.34

Chapter 9

Cemetery

9.1 Introduction

Complexity of Harappan society is best reflected by standardization, sophistication and utilitarianism in all spheres of activity, including planning of settlements and diverse crafts. To that may be added now the funerary monuments that Harappans raised in honour of the dead. Particularly, the Dholavira excavations[1] (1990-2005) (Bisht 1991:71-82; 1997:107–120;1999:14-37; 2000:11–23; 2001:26-28; 2005:11-25) have strongly highlighted the presence of multi-ethnicity in the Harappan society that iswell-nigh accepted by scholars. Among several singular contributions that these excavations have made towards understanding the Harappan civilization in a much broader perspective. Many new features, hitherto unknown, have been added.

One of them is a sprawling necropolis housing a variety of funerary monuments which, make Dholavira standing apart fromHarappa[2] (Wheeler 1946:85-90;Dales et al 1991:206:12) Lothal[3] (Rao 1979:137-69), Kalibangan[4] (Sharma 1999:17-98), Ropar[5] (IAR 1954-55:9; Sharma 1956:123), Chanhu-daro[6] (Mackay 1976:252-63), Rakhigahri[7] (Nath 1998: 41-43), Farmana[8] (Shinde *et al* 2008:64-78),Tarkhanwala Dera[9] (Gupta 1972:70), Surkotada[10] (Joshi 1990:364-71), a few othersand, of course, Mohenjo-daro with evidence of different kinds and contexts[11] (Marshall 1931:79-87; Mackay 1937-38:49,94-95,116-18, 648; Dales 1968b:61).Tarkhanwala is the solitary site which has revealed an evidence of cremation. Theevidence from most of the above sites has been discussed rather comprehensively by the excavators and others[12] (Singh 1900; Gupta 1972; Possehl 2002:157-76; Hemphill et al 1991:137-82).Surkotada andDholavira are, however, notable for two reasons. Both lie in a rocky desert of Kachchh and have yielded mainly the memorials. Sites like Cemetery-H at Harappa[13] (Vats 1940:221-45),Randal Dadwa[14] (IAR 1958-59:19), Chandīgarh[15] (IAR 1970-71:7-

8), Daimabad[16] (Sali 1986:175),Sanauli[17](Sharma *et al* 2006:166-79) and Bedwa-2[18](Kumar 2006:196-204) are posterior to the classical Harappan period.

It may be worthwhile to note that the Harappan territory consists of two different geologic and physiographic regions. One is the riparian plain, drained by the Indus and its tributaries and the Sarasvati and to that may be added the Gujarat plains diversely configured by the Rivers Bhogavo and Bhadar,western alluvial region of the mainland and the coastal areas in Saurastra and Kachchh.The second region is the rocky terrain of Saurastra, Kachchh, the Makran, Sindhi Kohistan and the adjoining flanks of Baluchistan. The former is devoid of stones for construction and as such,only earth was available for making brick, sun-dried or fired. Such building materialsare strongly vulnerable to natural forces which, in turn, may have considerably reduced or obliterated, in the prevailing tropical conditions,much of the overground features of funerary monumentswhich were usually made in an open landscape.

Many of them would be lying buried under the loads of alluvium and sand. So far as the latter region is concerned, it abounds in rock whichwas freely used for architecture. Luckily, the ancient ruins in these areas are, by and large, far better preserved owing to such natural and human factors as low rainfall, absence of raging rivers, lesser population pressure and limited cultivationbesides prolific use of stone in construction. We presume that many of the types of sepulchres which are noticed in Kachchhmay have been built in the riparian plainsas well but got denuded considerably.Barring Surkotada and Dholavira, a host of other Indus sites in the arid and rocky parts of the culturalempire of the Harappans have yet to receive due attention, particularly, in respect of the funerary monuments and mortuary practices.There are a few other sites in Kachchh, which apparently contain funerary structures with a promise of shedding welcome light on the subject. Kachchhindeed opens up a new line of enquiry in regard to the nature, practices and belief systems of a regional society within a territory which had the size and character of an empire (not necessarily a political one) under the Harappan hegemony. Now that Dholavirahas yielded a wide range of funerary monuments adding,not only a new dimension to the personality of the Harappan civilization, but also, perhaps, point towards a long

legacy that continued into later times in India, albeit with many a missing link as yet in the archaeological record in the subcontinent.

9.2 The Cemetery

It is necessary to state at the outset that the funerary monuments are scattered far and wide to the east, north and west of the city but the Harappan cemetery that has been fairly investigated lies in the west in a sloping landscape of a motley terrain of rock and soil. It is spread over an area that admeasures more than fifty hectares. It is strewn with a variety of funerary structures. A large area running along the Manhar is particularly crowded with such grave structures. Another significant topographical feature in the area is a nearly circular depression, now used for cultivation. Satellite imagery had suggested that the depression could be a buried water body and the same has now been vindicated by a limited archaeological probing that it was artificially created by the Harappans in order to store water remaining surplus after filling a cascading chain of reservoirs, provided all around within the city walls.

This water body seems to be of exceeding importance in that a series of five or six, large and high, hemispherical tumuli stand out noticeably on its bank while the regular cemetery spreads out fartherto its north, west and south, more particularly along the bank of the nearby Manhar. Many of them still survive intact while a good number have suffered varying degrees of damage by the nature and man down the millennia. Man is a bigger culprit who has wrought destruction for the purposes of reclaiming the land for cultivation, laying threshing floorsor campsites, or for making cart tracks. Recently, a large-scale damage has been caused while making a dam across the Manhar. Luckily, only the earth lying around the surface was removed, and the stones used in building sepulchres were largely left behind, although the superstructures of some of the monuments seem to have suffered from the vandalism. Further, it was most heartening that the most impressive tumulus was spared as it was used for anchoring the said earthen dam. It will be seen later on that it was an ostentatious funerary monument, hitherto unknown in the Harappan context.

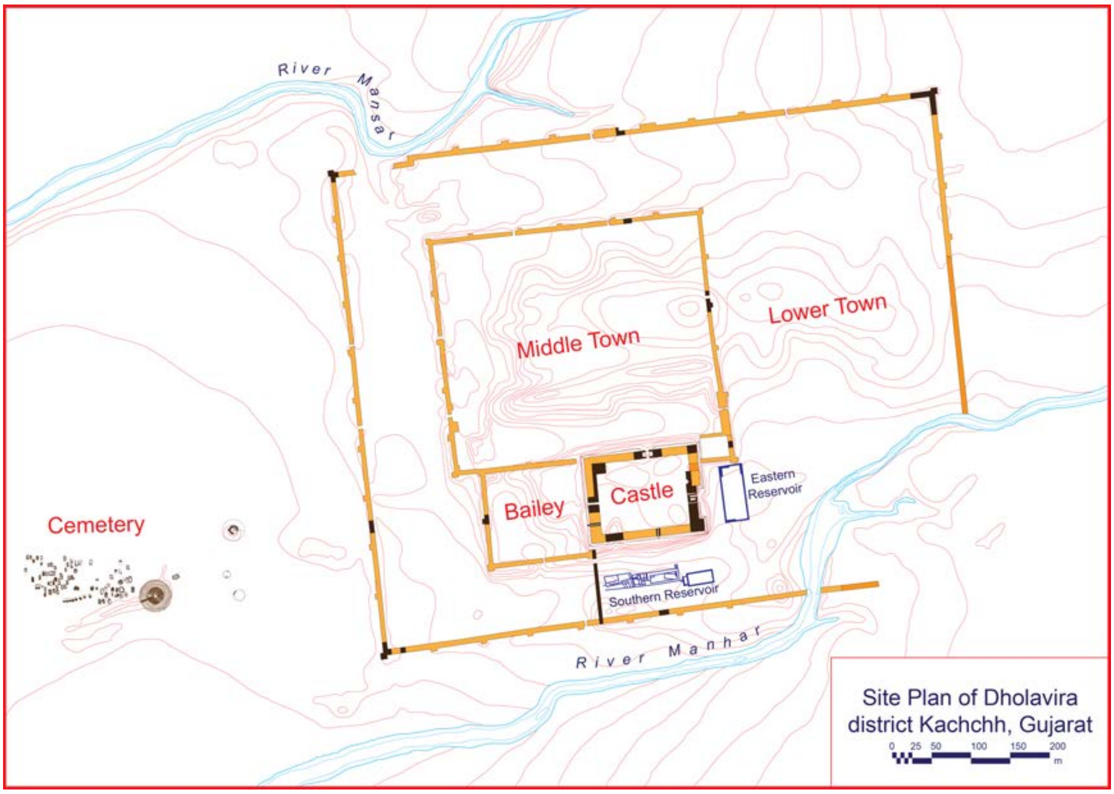


Fig. 9.1: Site plan of Dholavira showing location of Cemetery

Archaeological investigation was best concentrated in the western cemetery which is, on the present showing, exclusively Harappan. It is often referred to as main or regular cemetery also. It may be stated that, despite vandalism, many structures, of course, of less pretension are still far many. About three dozen of them have been investigated. All those are remarkable for providing a flood of information with regard to the diversity of shapes, sizes, architectural styles and construction techniques. Save for two examples of inhumation and a few fractional burials, all the sepulchral structures are bereft of any skeletons or bodily remains, while most of them contained offerings varying in quality and quantity. The offerings consisted mainly of pottery. In some cases, one or two beads and a little amount of gold were also formed part of the goods. Tumulus-1is exceptional in yielding one full necklace of steatite, a gold bangle and a few other luxury items along with a considerable assemblage of pottery.

At best, all these are memorial monuments, or say cenotaphs, raised in memory of the dead, thus suggesting a different mode of the disposal of the dead that the Harappans in Kachchh, particularly at Dholavira, had adopted whereas

the usual norm with the Harappans is said to be the interment of the body, laid supine in north-south direction with the head being placed on the north, in a grave cut rectangular that was obviously oriented N-S. At Dholavira, the direction of the majority of the cenotaphs remains almost the same, albeit with a few exceptions. The absence of skeletons in nearly all graves, barring few exceptions, at Dholavira and also Surkotada is, of course, of a great seminal significance.

The above is all about the western cemetery which belongs to the Harappans. It may be reiterated that the majority of the memorials, which have been unearthed in the cemetery, were found to belong to the three cultural Stages, viz. III, IV and V, while those of Stages I, II, VI and VII have remained elusive therein, probably save for one tumulus which is a conspicuously large, high and circular monument of mortuary nature. It lies at the south-eastern end of the said buried water body, not far from the south-western corner of the city wall. Two pieces of evidence in and around it suggest that it was some way connected to the people of Stage VI.

The first is that a long and wide pathway from the eroded top of the city wall to the tumulus was constructed by the late Harappans and secondly, the potsherds of theirs are found scattered on the top of the latter. So far as Stage VII is concerned, at least one grave was exposed on top of the deposit of the castle. Many grave structures of two or three types have been noticed over the ruins of different parts of the Indus settlement, particularly in the lower town area as well as in the near and distant neighbourhood of the site. Absence of tombs in regard to the first two stages (I, and II) may not be considered as negation of the practice, but only as a shortcoming in the present state of research. In the light of above, it will become a little easier to understand the sepulchral monuments at Dholavira in their suggested chronological framework.

The eastern cemetery is by and large historical in time although there are clearly a few late Harappan ones as well. On the strength of dense scatter of pottery the historical ones, seem to pertain to be the Kshatrapa period (1st--5th century CE).

9.3 Sepulchres in the neighbourhood

It should be relevant to record here that the kind of evidence that has been noticed at three other Indus sites, lying some kilometres away from Dholavira is worth mentioning. One of the sites, locally called Karani, lies by the side of the Jhandiasar Nala, well within the revenue jurisdiction of Dholavira. It is an open landscape amidst fields and some undulating rocky terrain. The site is located on the right bank of the Nala and houses a number of round cairns built on a rectangular platform raised. To the north-east of it, there are found two rows of rooms seemingly arranged in an L-shaped layout. At the face of it, those walled rooms appear to have been used by the persons looking after the mortuary functions as well as for the family members of the dead who gathered there to perform the last rites or even subsequent ones, if any. The pottery scatter littered there also suggests that some attendants were stationed there permanently for security of the monuments which possibly belonged to important person. One thing that is notable about the funerary monuments is that they are made of fine-grained, bright yellow limestone pieces of medium size without using mortar. Only an excavation may reveal the true personality of the site which holds a promise of yielding new evidence.

The other site, namely Ratnasarwali, lies at a higher place beside another monsoon channel falling in the village of Gadhada. It consists of three separately located components, viz. a small fortified settlement on the right bank of the torrent, a working / industrial area on the other side across the channel and a cemetery farther away, upstream. The cemetery, among several sepulchral monuments, contains two high platforms, each provided with four to five rectangular sepulchres. On one platform, the individual grave structures follow N-S orientation while on the other the E-W.

The third site, namely Khander as locally called, may have contained a cemetery of stage III as judged from the pottery collected from there. It lies to the north of village Janan and has been largely damaged for making a cultivable field recently. When visited it was found littered with pottery and bones while all stones

of grave structures had been removed and stacked on the sides. The very name Khander which literally means ruins is also significant. Although the surface features have since been erased in toto yet an excavation may brought to light some interesting still buried in the ground.

9.4 Types of funerary architecture

A limited survey and more limited excavation in the western cemetery have brought to light six major types, the type-I have three variants:

1. Rectangular memorial
   - 1.1 Built memorial
   - 1.2 Cist, or Cist in Cairn
   - 1.3 Rock-cut
2. Cairn: round, oval, long oval, or egg-shaped
3. Composite graves in a circle, a semicircle, or a rectangle
4. Fractional Burial
5. Inhumation
6. Hemispherical monument or tumulus

9.4.1 Rectangular Memorials

9.4.1.1 Built memorial

In the cemetery, visibly the most numerous are the rectangular structures. The majority of them are oriented along N-S direction while a few examples have E-W or NE-NW alignment in terms of longer side. Those excavated are built over similarly oriented pits cut into the ground. All of them were symbolical graves, furnished with one or two or a collection of pots. Many of

them contained one or more beads of semiprecious stones, occasionally with a bead or pieces of gold.

After the grave goods have been deposited, the pits are filled in with earth, sometime mixed earth rubble, and finally topped with a squat rectangular structure above the ground. Each such structure is found to be in accord with the orientation of the underlying pit. The offerings in the N-S oriented pit are placed or huddled normally in the north, either by its eastern or western side. In case of the pit being oriented east-west or, northeast-southwest the grave goods are placed on the east or the north-east, respectively. The placing of offering most possibly indicates the normal positioning of the head of the dead, had it been a proper inhumation which might had been the earlier practice in the society before the latter switched over to a new and different mode of the disposal of the dead and yet a structure was raised in memory. Old habits die hard!

Another noteworthy observation in regard to the rectangular type of sepulchres at Dholavira is that the sizes range from normal to small ones[*].Significantly, the area that lies to the west adjoining the Tumulus-1 and to the north along the bank of the Manhar is practically littered with such structures while, at places, those are intermingled with the other types as well. The built memorial, oriented in E-W direction, measured 3.35m and 1.10m in respect to their length and width. The example mention above was not taken for excavation.

9.4.1.2 Cists, or Cist in Cairn

The cists differ from the rectangular memorials rather in quality treatment for being linedand usually capped with large slabs limestone. Two cists, lying almost parallel to, and at a closedistance from, each other, and both being oriented N-S, are opened up for investigation. Both are located in that part of the necropolis where rectangular structures were preponderant and which liesto the west of the domineering Tumulus-1, and the Manhar runs close by, to the south of the area. Some special importance seems to have been attached to such cists as indicated by the use of fine quality limestone of pleasing yellow colour, sometimes with purple bands, for the uprights and the capstones.

The western cist (Grave no. 6) was in a fair state of preservation with its underground features being intact. It measures from 2.90 to 3.08 m N-S, from 1.60 m to 1.96 m E-Wand 1.12 m deep. Variation in length and width, to some extent, owes to the slight displacement of the uprights, not standing now in perfect vertical position due to the thrust coming from the sides and to the flow of earth with water percolation from the top.Most curiously, it contains a simulation of a coffin, made of fine- grained grey clay that is shaped into a highly stylized human form that is laid along the longer axis.

It was found to be smeared all over with a thin coat of red ochre. It measures 1.84 m long, 0.68 m broad at shoulders and about 12 cm in thickness, and lies at the depth of 0.73 m from the top of the upright. It is not placed on the floor of the grave, but is propped up with full pots and stone pieces which naturally rest on the level bottom of the cist.

The eastern sideline of the coffin though runs nearly straight, but for slight narrowing in the lower part, the western part can be easily perceived of three parts, viz. head, trunk and lower limb. While the head is imitated by curving the north-western part, the trunk by a straight line, the lower limb is shown by a marked concavity. The head portion measures 22 cm.

The southern line of the coffin-like terminates into two protruding stumps with a concavity in between, obviously for giving an idea of legs. Thus, the overall configurationimpartsto it semblanceof ananthropomorphic form. The conformation seems to convey as if the face of the dead was supposedly turned towards the west.

As expected, the replica of the coffin which is only 12 cm thick contained no skeleton as was confirmed when a piece of clay of it was cut out from its chest area. The clay it was made of contained few bits of charcoal which seem to have got into the earth, accidentally, certainly not intentionally, hence not suggesting presence of any ashes in it. Apart from those used as props under the coffin like feature, there are additional full pots, placed on the floor of the cist by the eastern side. In addition there are two more complete pottery forms.



Fig. 9.2: Grave No. 5, Dholavira

A little above, to the right of the coffin, is placed a water vessel while on the opposite side, nearer the head, is kept a dish-on-stand further, it is interesting to note that the western corner of the single slab that stood upright along the northern side is found intentionally broken to make a large curved opening, most probably, in order to serve as a porthole for facilitating to deposit subsequent offerings to the dead who was believed to be lying there in eternal peace.

The above mentioned vessel and dish-on-stand which are found inside seem to be part of original offering, if not inserted subsequently through the porthole. The cist was finally filled in with earth and covered with slabs a part of which has been found slipped into the grave while the others are missing save for some pieces found outside. Furthermore, there is another interesting subsidiary feature attached to the cist. A small rectangular area, enclosed by low rubble walls, is attached to it from the north where the porthole is.

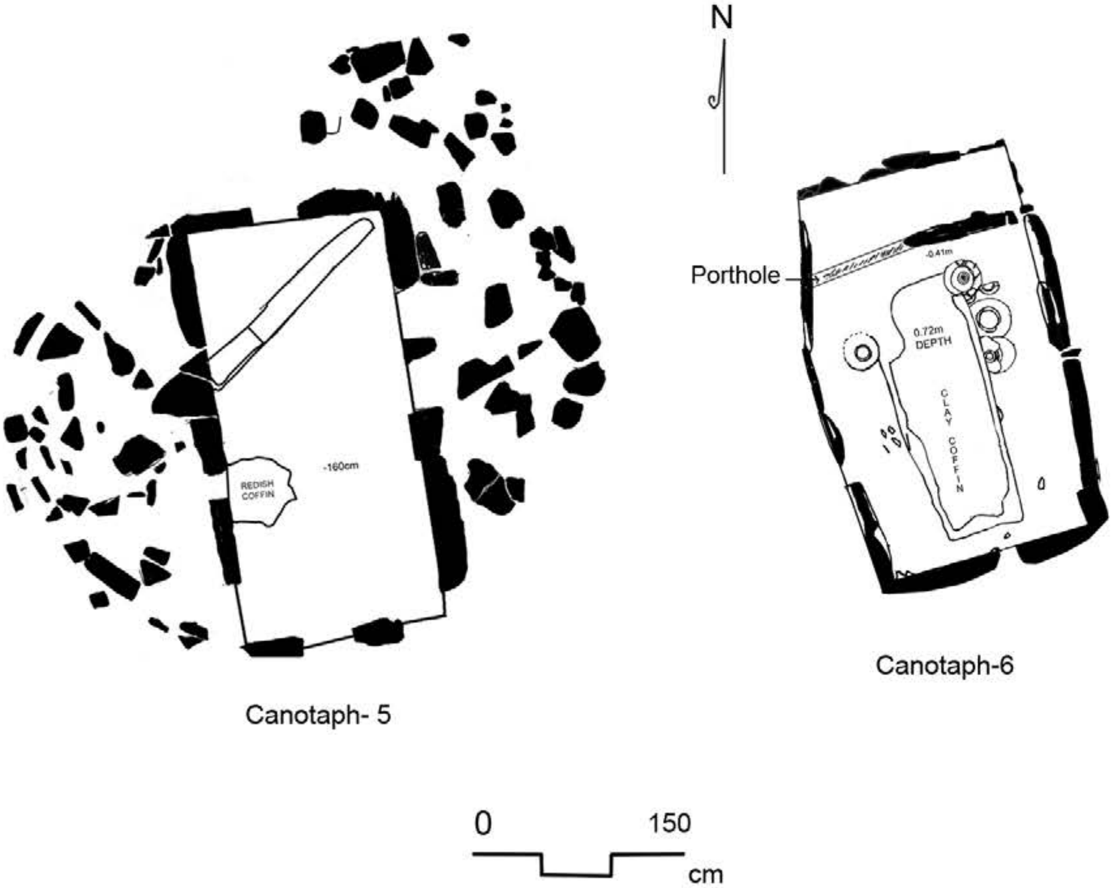


Fig. 9.3: Grave Nos. 5 and 6, Dholavira

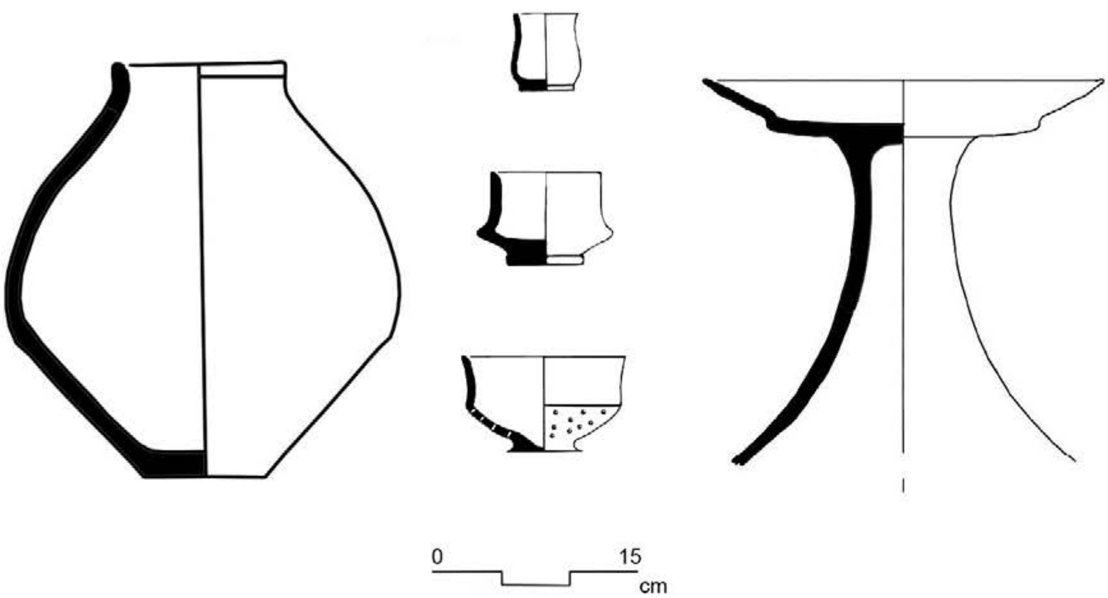


Fig. 9.4: Pottery from Grave No. 6, Dholavira

The walled area is enough to seat a person. It appears that it was meant for a priest or a family member to insert fresh offering into the cist after it had already been covered. Some features, faintly traceable outside on the surface, indicate that the cist was, perhaps, surrounded by a circular wall. At present, it is difficult to postulate whether there was small tumulus over the memorial. The other cist (Grave no. 5) which measures 3.18 m long,1.65 m broad and 1.60 m deep lies 4.5 m away towards the east. It follows the same basic form and construction style that pertains to grave no. 6 though it was found to have been wilfully disturbed, probably in hope of striking a cache. Its capstones were found broken and slipped into the chamber which got subsequently filled in with the water-borne earth. However, in the lower levels, there were found several pottery plates and some potsherds of red ware, lying certainly not in their original arrangement though, surely once formed part of the grave goods.

The surface around the cists seems to have been scraped off in recent time while making the said earthen bund. The vertically placed limestone slabs for lining both the cists and supporting the capstones were, therefore, found peering above the prevailing surface. Yet, it appeared as if the cists were once surrounded by a circle of stone, the outlines of which were feebly visible, although not figured out well as the area around is otherwise crowded with other graves, which sometimes run into, and thus partly damage, each other. It is not unlikely that the circular area was built over with a pile of earth or stones which have since been erased.

These are just two out of a few such examples which are visible on the surface of the cemetery. There are some memorials, likewise lined with smaller slabs or stones, but are of very smaller size. These are either furnished with pots of smaller size or none at all. Such structures either meant for the children or the builders did not indulge in expending more time and labour.

There exist a few cists, surrounded by cairns, in the necropolis. One such that is found lying in the ruins of the city liesto the west of the multi-purpose ground. Since it is not yet opened, no precise cultural context can be assigned to it. In any case, it should be posterior to Stage V for certain.

9.4.1.3 Rock-cut

Rock cut chambers, shallow or deep, may in fact represent an expansive variant of the rectangular type of cenotaphs. Four such examples have been investigated so far. Two of them pertain to the hemispherical monument sand will be discussed later on in the relevant context.

One of the rock cut chamber that lies somewhat halfway between two hemispherical monuments. It seems to have been completely evacuated and robbed sometime in the past and then got filled up by nature in course of time and a huge bush of cactus grew over it. From its overgrowth some large pieces of yellow sandstone were peeping out. At first sight it held out to reveal a well which would have been an interesting feature in the cemetery. But, on clearance, it turned out to be a robbed grave measuring 4.55 m N-S, 2.30 m E-W and 2.30 m deep (ratio 2:1:1). On digging, it yielded nothing but water-born deposit. Around the chamber there are large and heavy limestone blocks lying helter-skelterand a haphazard pile of yellow earth. While these stones appeared to be parts of covering slabs, the earth is what normally uses for making good quality mud-bricks although the source of a latter is not traceable in the neighbourhood, hence may have been brought from elsewhere. Very likely that the rock cut chamber was duly furnished with grave goods, covered and then surmounted by a mud brick superstructure of hemispherical form.

The other cenotaph came to light at an unlikely location in an unsuspecting circumstance. It was found during probing the cultivated field for ascertaining or otherwise existence of a buried water body GPR survey suggested the presence of ground sediments and yet indicated an anomaly, particularly at a point that lay at distance of 90 m south of Tumulus-2. It was deemed to be an ideal location to gauge the sediments in the oval area of cultivated fields, believed to be a buried water body, as well as check the said anomaly. On probing both turned out to be very useful. The sediments of 1.80 m thickness are found to be water-borne mixed with the Indus sherds occasionally occurring down to the bed rock, thus confirming the creation of an artificial lake by the Harappans.

The said anomaly turned out to be a rock cut cenotaph underlying 1.80 m thick sediments of which the basal layer of 15 cm thickness formed of light reddish sand of aeolian nature. The underlying cenotaph, measuring 2.85 m N-S, 1.42 m E-W and 0.90 m in terms of length, width and depth, is cut into the bed rock. Inside it there have been found three sets of offerings made on as many successive occasions, each represented bya set of pots, accompanied with some items of brick-a-brac, placed successively on a separately made earthenbeds from the bed rock upwards. The three offerings are found placed respectively at the depth of 20 cm, 60 cm and 90 cm. The lower most one included, besides pottery, three gold and three semi-precious stone beads. It is difficult to decide whether each set was meant for one individual or different members of a family or a clan. It is significant to note that the pottery was arranged in an order, not huddled haphazardly, as normally found in most of the graves.

The second issue pertains to the time of making this cenotaph. The pottery is unmistakably Harappan in form and fabric. As a rule, the pottery made for funerary purposes is usually poorer in quality in respect of fabric, painting and surface decoration. Application of slip is not unusual but paintings are quite rare to occur. A deeper study that is underway may decide the precise cultural stage to which the goods belonged. But the very use of the bed rock of a deemed lake for cutting a grave is quite intriguing.

The lake had certainly gone dry when the grave was cut. We, however, understand that the lake may have gone dry when the Harappan water harvesting system had collapsed irretrievably sometime during Stage V. The wind had spread over the lake floor a blanket of sand, when the cenotaph came into being. This postulate is, perhaps, more plausible as soon after the dry depression of the lake started being filled up by sediments year after year, century after century, until it was filled to the brim. The other situation which is less likely is that the cenotaph was caused to be made when the lake was passing through one of the dry spells during one of the earlier stages. However, the cenotaph is interesting for its location, for being cut into the rock under the lacustrine sediments, and also for showing an orderly array of the offerings.

9.4.2 Cairn

A few cairns, both of smaller and comparatively larger in size, have been opened up. Each one was raised over a round, oval, long oval or egg-shaped pit. We have already seen that there are sufficient indications that some of the cairns were raised over a cist as well. The number and variety of pottery as the grave furniture, or its complete absence, depended on the size of a cairn. Noticeably, some very small cairns are found being built over very shallow and small pits which were dug rather carelessly and have as aggar base.

Usually, such small structures are devoid of any goods. Many of these small ones are just 60cm across and 30cm deep hence just symbolic memorials. Some large circular cairns are upwards of three metres across. More or less, similar is the case with the oval or large oval cairns, of course with longer lengths. It is difficult to surmise whether a particular phenomenon is suggestive of socio-economic status, age, or gender the person in whose honour that is built. It may, however, be pointed out that there is no specific zonation for these type of structures as they are, by and large, intermingled with all other types of cenotaphs that are noticeable in the densely used area of the main cemetery. In some cases the underground pit was filled with the earth, and a few packed with the stones before raising an over ground cairn.

The elaborate examples are normally furnished with a large collection of pottery, usually placed in the eastern or the northern part of the pit. Such a placement is, perhaps, symbolical, as if to indicate as to where the head of the deceased should have been had it being an inhumation. Away from the regular cemetery, an open terrain, further north, is also dotted with grave structures of lesser dimensions. Some of them were investigated, but usually found empty.

Citing examples, three oval cairns provide max. length, max. width and depth respectively measuring 2.76 x 1.58 x 0.40 m (Burial no. 3), 3 x 1.5 x 1.57 m (ratio is 2:1:1) & 2.5 x 1 m while the round oneis 1.6 m in dia. and upwards of 0.30 m in height. There is another round cairn that registers dia. of ranging from

1.75 to 2m shows a rectangular chamber in the centre and can very well be put under type 1.2.

9.4.3 Stone-lined circle

There are examples of large circles, three-fourths of a circle, or a half circle containing inside a single or multiple grave-like structures. However, none of them has been excavated so far. Most likely, the details of construction and contents of such individual graves may, however, not be much different from such rectangular, circular or oval structures which have been excavated so far.

9.4.4 Fractional Burial

A solitary example of a fractional burial containing a human tooth and some small bone fragments in a shallow pit, marked by a stone upright at either end, has been found on the eroded slope of the southern margin of the middle town. It was oriented roughly along N-S. It is necessary to mention here that this part of the town was intentionally cleared of structures under a planning modification that was brought about subsequent to the devastative earthquake which occurred at the end of Stage IIIA. That vacated part was, however, reappropriated for constructing dwelling houses only during Stages VI and VII. The time of this fractional burial, although found seemingly in a room of Stage III A, remains indeterminate due to scanty evidence at hand not leading to any convincing conclusion whether the location was accidental or intentional. It is, however, certain that it lay on the top of the deposit of Stage III A and that no pit line was at all traceable in the overlying debris of much later stage. There was found no complete pots or objects although small potsherds of stage III were present along with the interred human remnants though both of them may or may not have been related to each other in terms of ritual. That, such a funerary practice was in vogue, albeit sparingly, during some phases of the Indus culture, is certain and hence this piece of evidence becoming interesting.

A skull is found stuck in a drain that descends from the castle into the bailey. It could be an accidental case of detachment from a later grave, built up higher up possibly during Stage VII, when inhumation was practised as will be mentioned later.

Some grave-like structures are noticeable just on the top of the defensive wall towering above close by. Similar features abound on top of the eastern wall-cum-stand of both the stadiums. At present, nothing much can be drawn out of it pending a proper investigation. One thing is, however, certain that all those should pertain to stage VI or VII, most plausibly the latter.

Another fractional burial in the cemetery is exposed to the south of the bundand only covered by a thin surface layer which sealed the human bones amidst a lot of broken sherds. The bones included a flat piece, probably of cranium, a radius, three phalanges and some bricks which could not be figure out well. The whole scenario was quite disorderly, again certainly due to the large-scale damage wrought in recent years. Even this was not clear whether it was a proper inhumation or just a fractional one.

9.4.5 Inhumation

Only a solitary example of inhumation (BR-12) is found so far in the regular cemetery. While sprucing the area in the cemetery a copper mirror was found on the surface. Later, when visible grave structures were being demarcated, the surface was scraped and an oval pit line, measuring for a max. length of 1.95m N-S and max. width 1.18m across E-W, was observed along with some bone pieces precisely in the find spot of the mirror. Further investigation brought to light a skeleton laid in N-S orientation with the head being placed on the north and the face turned towards the west. Part of its skull is found missing.

The head reclines against a pottery jar, kept in position, although a part of it is now missing, as is the case with of the skull of the dead, obviously due to its being now covered with a thin surface layer. The skeleton contains damaged cranium, shoulder bones, ribcage, mandible with denture, ulnaand radius bone of the arms along with phalanges, pelvic girdle, lower limbs with metatarsal while facial bones along with maxilla and teeth are missing. Some features like fingers

of left hand and left leg are not clear. Besides, there are found two pieces of a shell bangle which was once worn on the right wrist by the deceased. It was a female is judged by its anatomy and smoothness of the bones in addition to its association with the mirror and the bangle. The filling material, whatever is remaining is yellowish earth. The superstructure, if any, has since been completely erased recently by the villagers for collecting earth for raising the a fore said bund nearby.





Fig. 9.5: Details of inhumation burials

9.4.5.1 Later inhumation in the city ruins

Furthermore, the other graves with skeletons, normally without grave goods, or just with a pot as in one case, have been exposed, not in the cemetery but in the ruins of the lower town, although many grave-structures, have been noted in almost all parts of settlement, even on the defences, and in the south-eastern part lying on the other side of the Manhar, without showing any evidence of particular localization. All of them are certainly posterior to stage V.



Fig. 9.6: Inhumation of later period within the city ruins

An interesting example of internment, topped with a cairn, was opened at a high place near the north gate of the castle. It was a pile of stones, making a somewhat circular cairn. When opened, it entombeda skeleton in a shallow pitcut beside a structure of StageV. The dead is buried roughly in an E-W orientation. It is in a crouched position, with the head being placed towards the east and facing the south. While right part of the skull is missing, all other limbs are intact, albeit

somewhat dislodged. A chert blade found deeply lodged into a cervical vertebra indicates towards a possible cause of death of the victim in a fatal assault. A pottery bowl is placed in front of the face. Circumstance as well as the bowl indicates towards its pertaining to StageVII.

Some of the later burials, with or without the skeletons, have come up to view during excavation in the lower town which, as is well understood now, had been abandoned in Stage V and never occupied again for habitation. The skeletons interred in the graves suggest that the deceased had a robust body and ripe age at the time of death. There were no grave goods which could shed light on their time and cultural affiliations. All these sepulchral monuments are conspicuously visible on the surface.

9.4.6 Hemispherical monuments

Six hemispherical tumuli are the most conspicuous features of curiosity and promise in the zone of western necropolis. Those surround the aforesaid depression representing a buried water body and were believed to be of special significance in terms of their shape, size and location. Two of them, designated as Tumulus-1 and Tumulus-2, have been subjected to archaeological investigation which confirmed their being funerary monuments of exceeding importance and unique character (plate of pre excavation both the tumuli). As these tumuli ring an ancient (Harappan) reservoir and lie in the necropolis itself.

The investigation has also revealed that both the monuments share some common features and yet are two variants of one architectural form of pretensions hitherto unknown in the context of the Indian Bronze Age. Both consist of a deep and wide rock cut chamber, surrounded on the ground by a massive circular mud-brick structure made in two tiers, and finally filled in and topped with random earth, sand containing stone pieces. The building activity has involved five stages: (1) cutting of a large and deep rock cut chamber;(2) placement of offerings in the chamber;(3) construction of a broad circular mud-brick platform over the ground around the chamber; (4) raising of a peripheralring wall of mud-brick up on the said(basal)platform;(5) filling of the open shaft above

the chamber and within the encircling brick-work and raising it into a pile-up earth, etc. so as to impart a domical form to tumulus-1 and flattened top to tumulus-2.

So far as ritual offerings are concerned, those could be found only in Tumulus-1 in which the floor of the chamber has been struck though a small part of it yet remains to be cleared. It could not be possible due to the dislodgement of immensely large and heavy pieces of covering slabs. However, there has been found evidence of plastering on the exterior of Tumulus-1.Not unlikely that the Tumulus-2 was also treated likewise.

In both cases, it is also observed that the rocky surface, rising somewhat higher than the surrounding area with a slope towards south and east, was chosen for building the funerary monuments. Another activity common to both was reopening of the central area, at least once in case of the Tumulus-2and,perhaps, three times in that of the other one.

The points of difference which could be observed so far are two: (1) only Tumulus-1 was furnished with radial brick walls emanating from the peripheral rim of brick-work to run on the basal platform towards the central area, whereas the other one is devoid of any such walls, and (2) the central chamber of Tumulus-2 was covered with a huge capstone while the other did not yield such a feature.

The smaller tumulus, i.e. Tumulus-2, is discussed first, though investigated later, because of its comparative simplicity of design that may help comprehend other one easily.

Tumulus-2 stands on the northern bank of the buried water body. It has suffered a little from both natural and human vandalism. For more than two millennia, it has been exposed to the elements. In recent years, a local farmer has quite dressed it up from three sides, i.e. east, south, and west, for raising a temporary wattle shed for his seasonal stay there to tend crops. Nevertheless, it was in a satisfactory state of preservation at the time of undertaking archaeological digging.





Fig. 9.7: General view of the Tumulus 2 (left); Fig. 9.8: Details of interior of Tumulus 2 (right)



Fig. 9.9: Details of interior of Tumulus 2, Dholavira

Topographically, the tumulus (fig. & pl.) rises to a height of 3.35 m above the surrounding ground level while its diameter measures between 25 m and 28 m. These measurements should not be taken for real ones of the monument as much of the eroded material has spread out spherically over millennia. Subsequent excavation of the tumulus has shown that the diameter of the original construction should be about 22 m or slightly upwards whereas the height rises to 2.9 m though some reduction in the latter due to denudation is possible. It may,

however, be added that no segment in its periphery could be firmly ascertained from the limited dig that was made in a small cut in the southern sector where much of the eroded material, derived from the brick-work as well as the capping rock dust, has settled. However, the internal details with regard to the design and construction have been determined well. Mud-brick of varying sizes, such as 9 x 18 x 36, 10 x 20 x 40 and 11 x 22 x 44 cm, all falling in the Harappan standard of ratio, have been used in construction.

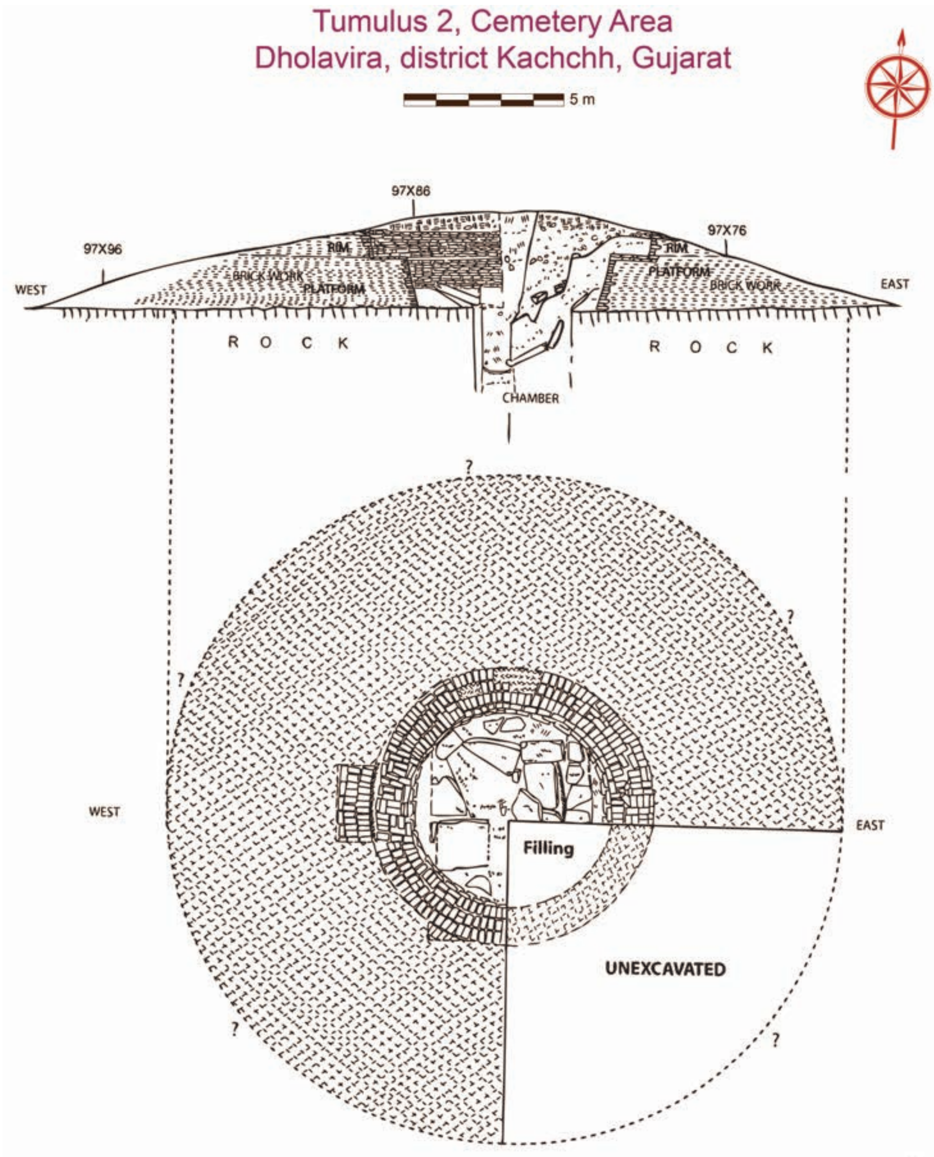


Fig. 9.10: Plan and elevation of Tumulus 2

From below upwards, there are apparently three major components: a rock cut chamber covered with a large stone slab; a two-tiered mud-brick construction encircling the chamber; and a sand filling topped by rock material.

The rock cut chamber measures4.60m along N-S and about 3.04 m E-W (ratio 3:2), while its depth is ascertained only to about 1.80 m, beyond which further digging was prevented by the enormously large and heavy pieces of the fallen capstone, broken and slipped into the chamber until the last season (2005) of the field work came to a close.

As stated above, the chamber is cut into a sloping rocky surface and the encircling brick-work is made of two tiers, sitting on each other. The circular lower ring of the brick-work, round the rectangular chamber, is broader and thicker and thus naturally registers variable distance from the latter. The upper brick-work is receded by 1.20m to 1.55mfrom the lower one thus rendering the whole construction a terraced formation. The vertical sides of both the brick work register an outward batter. As a result, the internal diameter of each, like a funnel, becomes progressively broader upwards resulting in providing a telescopic form. Resting on the sloping terrain, the lower one forms the basal platform which is made of 18 to 19 brick courses registering a height of 1.72 m to 1.80m,of course, with the said batter. As a result, the central shaft, encircled by the brick-work, is narrow at the base and wide at the top, hence diametrically measuring 5.30m and 5.60m respectively. Similar is the position in respect of the upper brick-work, too. The enclosed shaft in this case increases likewise from 6.22m to 6.52m from below upwards, and as such the internal diameter of the shaft increases from9.15mat its base to 9.40m at the top. The top of the brick work has been largely eroded but is present in the eastern part where its full height of 0.88m, through 9 courses, making a flat top, is preserved. The earthen filling rests there right upon that top. To sum up, the lower brick work serves as the basal platform which sports a broad ring wall running round the periphery. In the absence of a cross section and /or finding the outer face of the monument, it is stated that the respective width of both the brick work is not available at present, although it is conjecturable in view of the estimated diameter of the monument.

The chamber was originally intended to be covered with a single huge slab which was now found to have been broken into upward of a dozen pieces. Apparently, the pieces seem to be fitting into each other quite well, thereby suggesting its monolithic character. If that be so, it naturally surprises one as to

how it was separated from the parent rock, transported and finally placed over the chamber of large dimensions. Question arises about the time and the cause of its breakage. It is very likely that the chamber which was surely meant for a mortuary ritual or for depositing of the ritual offerings which might have been made in a ceremony that was, perhaps, performed somewhere else, outside the monument. It is strongly possible that the chamber was left only with the said ritual wherewithal and then covered with the monolithic slab, thus having a huge space lying empty inside it.

Once it was capped the area around was enclosed by both the massive brick-work which have been discussed just above. Finally, the central void, i.e. the circular shaft, enclosed within the brick-work, was filled in with loose sand mixed with stone pieces and then topped it with hard earth. It appears that the capstone under the heavy deadweight of the filling gave way and broke into pieces and collapsed and thus allowing the sand of the filling to drift in. Naturally, the earth above also subsided thus necessitating more piling up of earth which rather very hard rock dust is mixed with rock pieces, all whitish in colour. It seems that the rock powder and pieces, obtained during excavating the chamber, was kept aside to be intentionally laid at the top of the pile-up to minimize the effects of erosion.

After certain depth, it became imperative to remove some of the pieces of the capstone in order to go deeper into the chamber. Most of the pieces were so large and heavy that only one of them could be removed that too with the help of two tractors working simultaneously for pulling it out. Yet the objective of fully investigating the chamber could be achieved because of the other pieces of the covering slab. We do not know what were the offering originally placed in the chamber. It is, however, very significant to note that, at a later occasion in the past, a shaft was cut from the top through the filling, perhaps, in order to deposit fresh offerings inside the chamber. But the shaft could be sunk only to a depth of 4.70m beyond which those diggers, too, failed to go deeper for the same obstruction which was confronted by us. Interestingly, those placed a fresh offering, now represented by two full pots at the depth we stopped.



Fig. 9.11: General view of the Tumulus 1



Fig. 9.12: General view of the Tumulus 1

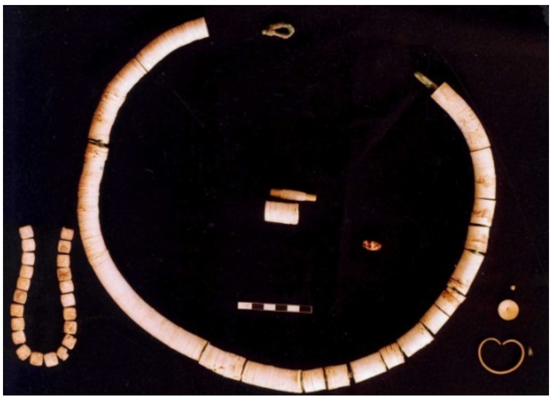




Fig. 9.13: Details of the funerary offerings inside Tumulus 1

Tumulus-1 is larger in size and stands on the north-western bank of the buried lake, at a distance of about 75m from Tumulus-2. In its extant form it is conspicuously hemispherical in shape. The spread of the tumulus before excavation measured 33min diameter and 2.90m in heightfrom the surrounding ground level, the latter with a tendency to slope towards east and south as in case with the other one. It was subjected to probing in several spells due to its being riddled with several later additions and interventions that were made continually one after another over centuries during the later half of the third millennium BCE in particular. These later features, which were made into and upon the monument, rather haphazardly than orderly, had not only caused much damage to the surface of the monument but also brought about changes in its morphology, and rendered the excavation challenging and difficult.

Surface clearance had shown that the monument was a baffling mess of brick work and stone masonry giving little clue to its real character, excepting its location in the necropolis and on the bank of a depression, besides its hemispherical form, all indicating towards its being an imposing funerary structure. While its north-western half is largely better preserved and the brick-work all over was fairly perceptible, the counterpart housed a number of later graves and other structures made of stone. Those graves too in many cases were found cutting into each other.

The north-western part shows many successive brick courses ringing round on the slope for a considerable height (plate).The clearance has shown and suggested that the outer part of the tumulus, roughly to a height of 2m, is an orderly arranged brick work, while the remaining one meter high part with as many as eight radial walls of single brick courses, which radiate from the upper ring of brick mass and move towards the central area. One more radial wall in the south-eastern part is visible although not marked for its bricks. Beside, two or three similar walls made of single line of stones and at least two fragments of similarly made ring wall are also visible. At least in one case a radial brick wall were restored with stone. Of all, three radial brick walls are better preserved while the others have been disturbed by later interventions to a varying degree of damage. The central part forming an oval with its longer axis being N-S was seen

as a large pit making fairly flat top. In addition to all these there were number of stone built feature many of which were clearly the graves different shapes and sizes, topped with stones. All this was the phenomenon on the surface after clearance and before making deeper probing in selected area.

Given to the unusual shape and complicated nature of the tumulus, a 20m long and 2m wide trench running SW-NE was laid almost two-thirds across the area, that obviously departed from the general grid plan. To begin with, the work was started from the west where the exterior face of the brick masonry has been found bearing a 10mm thick plaster of pinkish-white clay, extant to a height of 30 cm.The work when continued upwards, over the slope, ascertained a well-coursed brick work having a width of 7.50m and curving circularly in accord to the visible periphery of the hemispherical tumulus. And, further up started the zone of the radial walls, two of which were due to fall in the trench under reference.

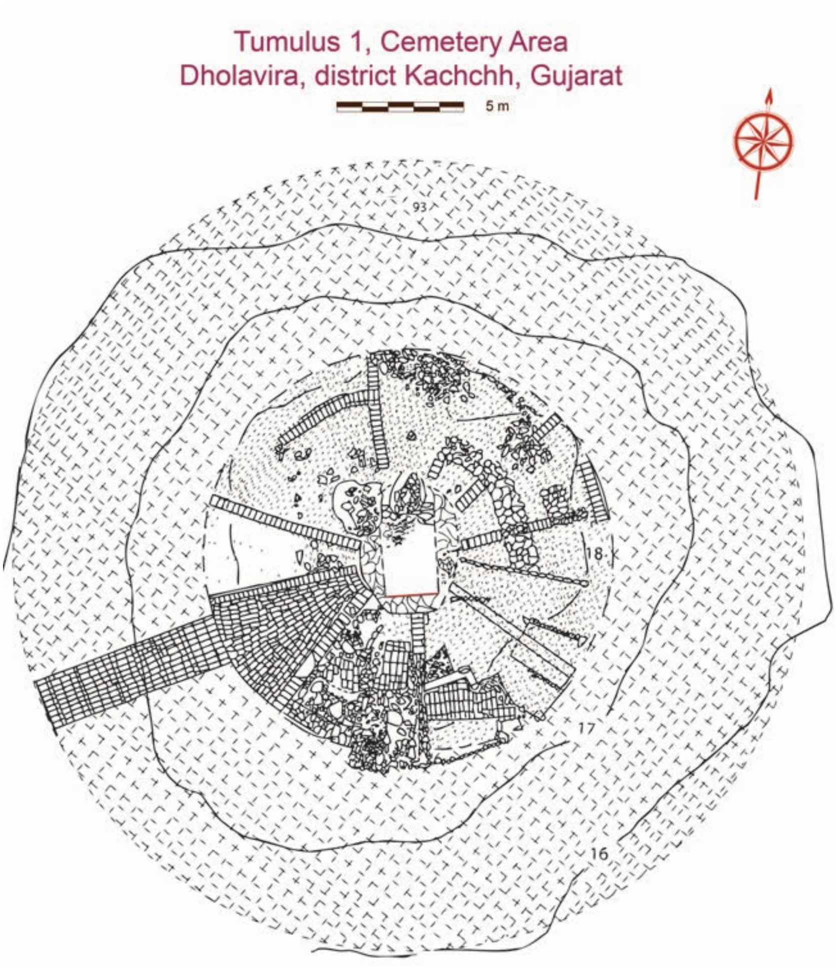


Fig. 9.14: Plan of Tumulus 1

The segment between the said two radial walls of mud-brick was chosen for excavation. The probe has revealed many interesting features: that those walls emanate from the inner face of a massive brick work that is variably extant to a height of 1m, which in fact gives the extant rise of the peripheral ring wall standing on a brick platform; that the radial walls have been built in two successive phases, with a long time gap in between; that the same walls run towards the centre on a brick–made floor that is top of the circular platform; and that the large oval pit in the centre have truncated the other ends of these walls; and also that the central pit goes down right into the rock cut chamber.

The two radial walls in this trench stem 3.60m apart from the peripheral wall. The interface has an earthen filling mixed with stone and some pottery. Curiously, the first layer is predominantly made of rubble of different sizes and overlies a neatly constructed brick floor, which subsequently turned out to be the top of the circular platform having several brick courses. Towards the central area even rubble are used to a certain length for making the first course of the walls clearly for raising their respective height. In this trench, the radial walls demonstrate two phases of construction. In the central area both the walls seem to have truncated by the aforesaid central pit. This probe provided ample clue for dealing with the monument with confidence.

The subsequent operation has revealed that, like that of the Tumulus-2, the whole construction is quite simple and highly symbolic and similar, except for the radial walls and the flat top. It has four components: rock cut chamber and the offerings, successive phases of filling; a broad and massive ring of brick work round the chamber forming a basal platform; enormous peripheral rim of brick work on the said platform; radial walls on the platform and filling between the walls. These, however, exclude the later intervention, like opening of the central area through the chamber, and raising of a curved wall, a few partly preserved radial walls, segments of ring wall, and several graves in certain part on the pre-existing monument, all made of stone in this ultimate phase. Initially, the built-up height of the monument was lesser in the first phase and got increased in the second.

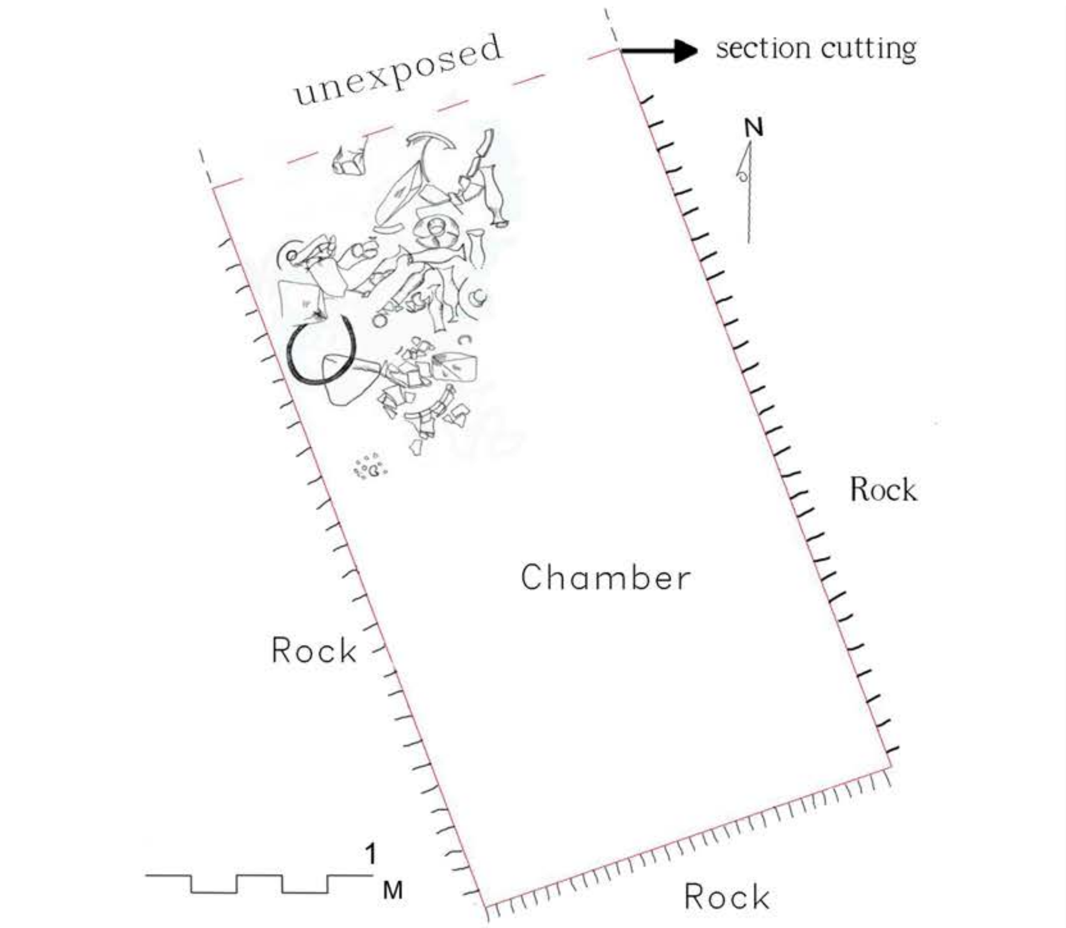


Fig. 9.15: Rock-cut chamber with offerings, Tumulus 1, Dholavira

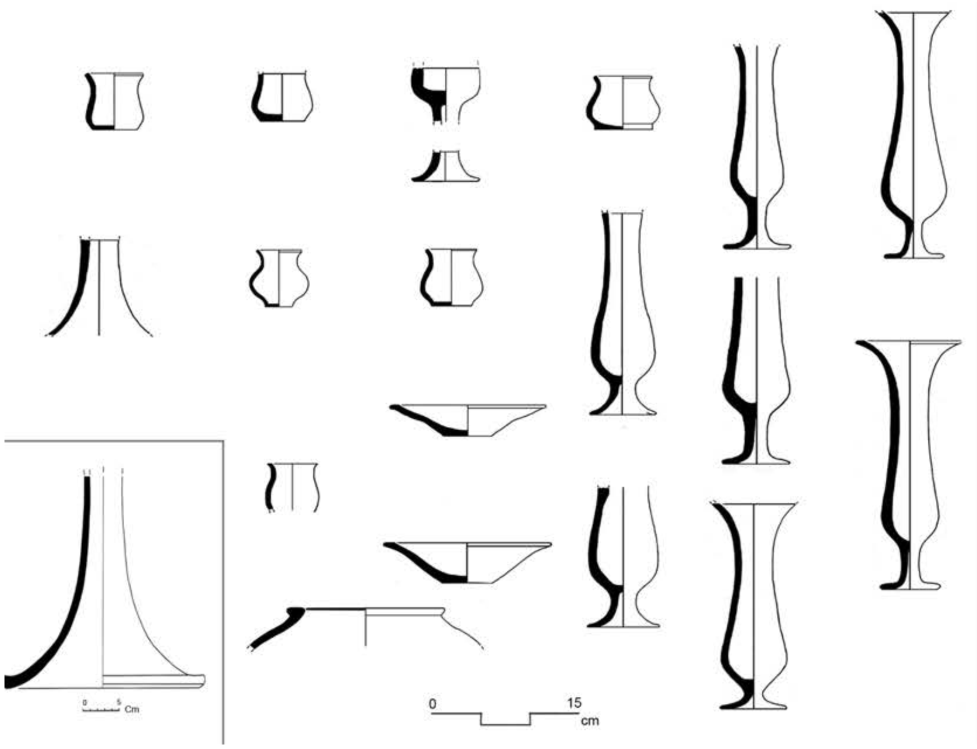


Fig. 9.16: Pottery from the rock-cut chamber, Tumulus 1, Dholavira

To what extent the third phase caused further raising is not certain due to erosion of the surface, although it might not have brought about any substantial change in form and height. But human vandalism seems to have caused some damage by way of removing stones from the structures in order to make a small platform atop the monument-a practice still followed by the herders to keep a watch over their flocks. The presence of a large number of graves of varying sizes and shapes, and equally varying in orientation, seem to be built on the monument. Some of these stone-made graves were, perhaps, coeval with the introduction of masonry radial walls of the ultimate phase. Some of the graves are surely posterior to the latter.

The rock cut chamber, occupying the central position in the monument, measures 1.90mwideE-W and as much deeper, while its length can be traced only to 3.60mN-S at the time of the closure of the last field session (2005) when, due to time constraint, it was not be possible to remove the overburden of 5m of the filling. Not unlikely that the length of the chamber may be 20 cm longer thus making it around 3.80m. If that be so, the ratio would be 1:1:2 in terms of depth, width and length as this ratio has been found in many of the rectangular graves at the site. Most significantly, the chamber contained a rich cache of the offerings of pottery and jewellery, and a part of it is still lying buried under the said heavy overburden. On present showing, pottery includes eight tall, pedestaled vases, small pots, a few medium-sized jar sand dish-on-stand. While the majority of them are plain, unslipped, undecorated and made of coarse-grained earth, a vessel with a short neck and externally projecting rim bears crimson slip and decorated with two black bands round the neck. In this case, as in case of the pottery from other graves, the general impression that one gets is that it is specially made for mortuary ritual, and hardly met with in the domestic corpus at the settlement. The jewellery consists of a solid gold bangle having incurved ends, a gold bead, agate beads and a complete necklace of large disc beads of steatite stringed in a copper wire with its both ends being turned into hooks for interlocking. The offerings are found being placed on a prepared earthen bed made on the floor of the chamber, but there is no orderly arrangement in there

placement. Those are rather huddled, mostly towards north and west in the chamber.

The central area, which looks like an oval pit as exposed on the surface, measures roughly 5m N-S and 3.80m E-W. The pit, which narrows downwards, contains above five metres of filling which is consisted mainly of five strata descending right into the rock cut chamber and pertaining to three stages of filling made successively. Interestingly, there is found two sets of random rubble and sand mixed compact earth, occasionally containing pieces of mud brick as well as chunks of brick masonry. The layer at the top is made up of compact earth freely mixed with white clay. Intriguingly, the layer at the bottom, which mostly goes into the chamber, pre-dominantly contain the random rubble which were thrown in recklessly right upon the offerings deposit on the floor of the chamber thus causing much damage to the pottery particularly that that was manufactured carelessly. The mud brick chunks surely pertained to the masonry of the platform and the radial walls.

The periphery of the basal brick platform, running round the chamber, has been determined in the western part of the 2m trench which has also shown that some part of the inner face of the platform has suffered slicing off by the central pit. The exterior face of the platform bears a pleasing coat of plaster of pinkish white clay as already mentioned above. The platform is now extant with a thickness of 13.70m and registers a height of 1.90m through 17brick courses rising from bed rock. The bottom course rests on a prepared bed of white clay, or else, this white clay base may be in fact the top most layer of the weathered bedrock itself, which is, moreover, made of colourful bands of petrified clay that is exposed almost around the monument. As has been said time and again, it is with the help of this valuable piece of evidence, duly fortified with other tell-tale features, e.g. the spread of brick work exposed on most of other parts on the extrados, etc., it is concluded that the monument has a diameter of almost 30m. While arriving at this conclusion, other pointers, although infirm, like the irregular line of the central pit which is co-incidental to the inner curve of the rim wall has also helped delineate the periphery and centre of the monument.

The basal platform has have two functional, not constructional, parts: the outer part supports a 7.50m thick peripheral ring wall, i.e. the rim; the inner part serves as the base for radial walls, which emanate from the former to run across to converge, somehow, in the centre which, however, remains elusive. Investigation has already confirmed the existence of eight mud-brick radial walls while the ninth was traceable on surface, and the tenth is conjecturable in north-western sector. In all, thus there may be ten radial walls. Nevertheless, it is wondered whether the builders intended nine radials only. Strangely enough, these walls are not symmetrically placed at an equal distance at the points of their issuing from the inner face of the rim wall, nor converge on a single common central point. Presumably, there may be more than one point where different sets of walls meet each other. Besides, every two radial walls provide a different angle at the point of joining nearer the centre. If every two walls are allowed to join together at their respective points of convergence, the differential angles from the northern wall in a clockwise fashion seem to read in seriatim 40˚, 34˚, 40˚, 27˚, 43˚, 38˚, 35˚, 37˚, 30˚, 36˚, respectively. This presumes the existence of presently non-existent tenth wall, however. If there is not a single point of rendezvous it is not unlikely, these walls were somehow oriented in connection with the rectangular rock chamber under an ideological principle that governed the architecture of the whole monument. Nevertheless, and vividly, these walls run like spokes in a wheel, of which the peripheral wall makes the rim, i.e. the felly, and the symbolical construction is raised on a circular platform making the traditional *vedī*.

The radial brick walls have, as said earlier, three phases of raising, the first two with mud-brick and the last one of stone. The radial walls reveal very significant feature in that each of the two walls which have been fully exposed in terms of height and extant length, both vertically and horizontally. Both continuously rise from the rim towards the centre. In other words, as each wall moves towards the centre its courses go on increasing in number and thus attaining height. The lower one has 4 courses registering a height of 0.50m at the point of its origin at the rim and increase to 8 courses through the height of 1.06m at the eastern end where it is truncated by the pit. Similarly, the upper wall has 3

courses registering a height of 0.27m at the western end and 5 courses through a height of 0.50m as of now preserved at the eastern end. As a result, the height of the monument gradually increases towards the centre, thus imparting to the monument a perceptibly domical form. While the bricks of the first phase are made of compact yellowish clay and laid in a fine work man ship, as seen in the basal platform as well as the rim wall, those of the second phase are of loose greyish clay and coursed comparatively in inferior style. So far as the third raising made by using stone is concerned, it is very poorly preserved, only in segments, on account of their remaining exposed on the surface as well as poor workmanship and later pilferage. Many of them are missing as these are made of small stones placed quite carelessly. Nothing more of that phase may be added except that the majority of the graves which were built up subsequently on the monument have also disturbed these stone-made radials as well as thin ring wall, which are now present in fragments only. Filling of the interface of the walls was, perhaps, the last act.

How the central part that is disturbed by the pit was treated with is difficult to surmise. Today it is flattish. But, there arises the serious doubt whether monument was ever topped with a pile of earth as seen in the Tumulus-2. The way the radial walls have shown an upward rise on all sides, it is very likely that those were constructed right up to the top. And, in what manner the top was finished is also not easy to visualise. An interesting feature that is preserved in the north-western part of the extrados, where the inner circle, i.e. the zone of the radial walls and the filling, is seen veneered with mud-bricks (PLATE).It is most plausible that the whole monument was originally treated likewise.

In its present state of preservation, the entire monument presents indeed a hemispherical form. It is difficult now to decide whether the builders intended to make it as such from the ground itself, or, the brick work of the basal platform, or this together with the felly, was raised as a cylindrical drum up to the former in the first case, or up to the latter in the second, and then the radial walls were constructed with a slight rise towards the centre and the interface was filled up in order to make a low domical top, or else the central part was kept flattened. And, finally the whole was covered with bricks and plastered.

Encasing of the dome with bricks seems to be in evidence in the north-western part were as the remaining area has been considerably tempered with. If the small part of the plastered exterior, although too low for an absolute inference, seems to be valuable piece of evidence to suggest that the semi-circularity of the monument was intended from the beginning. If so the hemispherical exterior may have been obtained by way of externally offsetting each of succeeding brick courses while building.

Howsoever meagre is the evidence of plastering, it is, chrono-culturally speaking, highly important. On excavating at the settlement, it has been observed that the use of coloured clays, white, off-white, pink, for plastering all structures, whether a fortification wall, embankments, house walls, house floors or terraces and stands of the great grounds, was almost universal during stages II and III, and partly as well in stage I. But this practice was completely forsaken from stage IV onwards ‘as if there was a social taboo or royal decree against it’. It is, therefore, obvious that the use of coloured plaster broadly serves as a cultural chronogram at Dholavira.

If the history of the monument is to be recounted, it was built in stage III, partly raised in stage IV, provided with radial stone walls and finally used to support a variety of graves during stage V. This deconstruction is duly supported by two pieces of evidence. While excavating at the site it has been observed that the people of earlier three stages were carefully choosy about the kind of earth they used for making mud-bricks. It was always a very good quality bright yellow earth. Besides they also preferred white, pink and red earth for the same purpose as well. The same care was taken for selecting right kind of earth for preparing mortar. Brick-laying is always exquisitely fine and then comes the use of colourful clays as well for plastering and flooring.

Secondly, the potsherds, collected from the brick work of the basal platform, the first phase of radial arms and the filling in the interface, pertain to stage III, while those from the subsequent structural phases relate to stage IV and V respectively. It is apparent that the very idea of building a hemispherical or domical monument over a circular platform supporting and intricate and highly

symbolical layout in honour of the dead preceded the onset of the Harappan classicism sometime between c. 2600-2500 BCE. Impressive form, architectural intricacy and underlying symbolism suggest that the monument was built in honour of an exceedingly important person, most probably from ruling family, and as such it was held in high esteem as suggested by phases of successive raising. Further, towards the final phase it had acquired such sanctity that it was made last home for several persons probably belonging to the same family. It makes one recall of the second Mughal emperor Humayun'stomb in Delhi where upwards of 150 members of the royal family, including the two princes of the last Mughal, Bahadurshah Zafar, have been interred in the basement chambers of the monument and its surrounding terrace during three hundred years of the succeeding fifteen rulers.

The Harappans got it in legacy which they cherished for sure and bequeathed to the posterity. We propose that both the monuments are made in the form of a wheel in which fire-altars as well as funerary altars were made as duly corroborated by both archaeology and literature. Furthermore we also propose to compare tumulus-1 with sāra-*ratha-chakra chiti* and tumulus-2 with*sapradhi-ratha-chakra-chiti,* both of which are dealt with in the *Śulba-sūtras* which contained the rules for ritual geometric constructions of the Vedic altars.

In the following paragraphs an effort is made as to where and when such monuments were raised and as to what the ancient Indian literature speaks about.

9.4.7 Wheel-type monuments in archaeology and literature

9.4.7.1 In archaeology outside India

It has already been mentioned that the hemispherical monuments of Dholavira have no parallels in the any protohistoric (Harappan included) cultures in India. Most significantly, their analogies in protohistoric context have been found almost 1300km away (as the crow flies) in the island of Bahrain in the Gulf, which has been considered the largest graveyard in the world of yore. Harappan

connection with Bahrain is well established owing to the presence of seals, weights and some pottery forms[19] (Srivastava 1991: 26-27; Laursen 2010:131-32, 134). Now the same can as well be seen in the funerary monuments in terms of morphology and, to some extent, in architectural details, of course, with somepoints of difference which are more related to the belief system and ritual.

The island has yielded a variety of sepulchres which have been categorised in four main types by Srivastava[20] (Srivastava 1991:14-15), while Laursen[21] (Laursen 2010:117-22) classifiesthem chronologically into early, transitional and late types with due consideration tochanges in morphology. We are, particularly, concerned about the latter's 'conical' and 'radial wall types 'of tumuli/tombs which have been broadly dated between circa 2200-2000 BCE by most of the archaeologists, despite the tenuous footing of the Bahrain (Dilmun) chronology of archaeological records. In the following paragraphs it may be seen that the conical monuments show much semblance to Tumulus-2 of Dholavira, those called 'Radial Wall Type' bear that to Tumulus-1.

The conical tumulus at Bahrain has a grave chamber, made of stone over ground and covered by much wider pile-up of earth mixed with stone pieces, which in turn is enclosed by a ring wall, sometimes more than one built at different levels. In terms of diameter and height, those range from 5.45m to 11.60m and 0.65mto 2.32m respectively[22] (Srivastava 1991:45-182). The radial type tumulus also rises from the ground around a stone-made grave chamber and differs from the former on account of being furnished with radial walls emanating from the ring wall which circumscribes the whole monument and has a flattened top. Number of radials varies from 1 to 13[23](Laursen 2010:120) while the diameter of this type ranges from 9.40m to 13.43m and height from1m to 1.90m[24] (Srivastava, *ibid*).

Both the types of Bahrain are monumental in nature, the second one, of course, being more pronounced in dimensions. Unlike the Dholavira ones, all carry skeletons, along with pottery and animal bones usually placed in position. The most significant is the find of a round seal bearing a legend in Harappan script, a peacock and a humpless bull with lowered head and typically classical

Indus grooved boss at the back, which was found in the grave No. 1757[25](Srivastava 1991:99, fig. 18), which was incidentally furnished with radial walls and a flattened top. Srivastava has given a general time bracket of c. 2200-2000 BCE to the graves dug by him while Laursen is more specific in dating them between circa 2050-2000 BCE. Importantly, the solitary round seal in steatite from stage V of Dholavira has, not only the same humpless bull as motif, besides a four-letter inscription in which the last two letters (in positive impression) of the Bahrain one are almost same as the middle ones on the Dholavira specimen. These are two standing human figures and a staff. In this regard, the solitary find of the Gulf type seal from Lothal is also interesting. All these fit well in the above–mentioned time-bracket.

Contrary to Dholavira examples, the Bahrain monuments usually contain a human skeleton in flexed position, facing to the north, laid in east-west orientation, and there is no use of mud-bricks. Neither is there the basal platform nor an enormously broad ring (rim) wall. In the Bahrain tombs, the ring wall(s) are far much thinner and are made of stones, which are comparable to the similarly made stone walls of the ultimate phase, if not to the brick ones of Dholavira and yet the symbolical connotation is equally strong. It is very tempting that the inner part, showing the radial walls and the chamber in the centre of Tumulus-1 at Dholavira, intriguingly appears to be very close to what the Bahrain examples reveal[26] (Srivastava 1991: 14) as tabulated below:

Mound No.	Pages	Figure No.	Plate No.	Reference
1844	87 – 88	13	IX a.	Krishna 1991
1757	99 – 100	18	IV a., X b.	Patil 1991
1406; 1424	119 – 122	30 – 31	XXI b.; XXIII b.	Patil 1991; Sinha 1991
1812	129 – 132	19	XIII b., XIV a, b.	Sali 1991
1423	145 – 146	22		Saar 1991
1798; 1804; 1425; 1753	151 – 158	32 – 35	XXIC a.; XXCIII b.; XXVII b.; XVII a, b.	Patil 1991; Krina 1991; Kaul 1991; Ramachandran 1991

The mound no.1812 is particularly attached with 5or 6subsidiary graves outside and one within the ring wall. In this regard, Fig. 6 of Laursen[27] (2010:

120) is the most eloquent in having as many as 13 walls radiating from the central chamber to the ring wall. There are also six subsidiary graves attached to the ring wall from outside, most probably at subsequent occasions. It is not unlikely that a few of the radial walls were added by those subsequent grave builders. For conical type of tombs good example are mound numbers 1417, 1746, and 1793[28] (respective plate no. VIII b, XVI a, and Xx a vide Srivastava 1991).

The chronological framework given to the Bahrain tombs very well corresponds to Dholavira V, Lothal V, Nausharo IV, Harappa IIIC and so on. This was the time when Mesopotamia was in political turmoil and the Harappan economy was under severe stress when the brisk trade between the two snapped. It is generally believed that this was the period when Dilmun (Bahrain) emerged as a strong intermediary. We would like to hazard a postulate that the Harappan merchants made Bahrain and Fialaka their strong trading foothold and carried over there their mortuary practices and architecture. In the whole scheme of design of the radial wall type of tombs of Bahrain, scholars see an underlying symbolism of sun or star[29] (Laursen 2010:120). Hereunder, we will discuss how strong has been the ideological symbolism that underlay funerary monuments in India.

9.4.7.2 At home

The stupa architecture so largely popularised by Buddhists in India one and a half millennia later and further onwards, manifests strong religious symbolism in its morphology and layout. The stupas at Sanghol (Panjab), Alluru, Nagarjunikonda (Andhra Pradesh) have in particular revealed the basal layout designed like a spoked wheel, which surely symbolises the wheel of *dhamma* (faith) that Buddha set in motion at Sarnath. Since the proclamation was of paramount importance the wheel became the most scared symbol in Buddhism hence its replication in the layout of a stupa has a special ideological connotation. A stupa is quintessentially a funerary monument which in the Buddhist faith has become an embodiment of Buddha himself as well as highly venerable

personages. So far as the antiquity of the tradition is concerned, Buddha himself has referred to the existence of the stupas of yore and enjoined on his followers to pay homage to them. Some of the hemispherical tumuli of Nandangarh (Bihar) have long been considered as pre-Buddha in time.

9.4.7.3 In literature

Besides, some of the sepulchral forms, which the Harappans created, more diversely at Dholavira, and also the mortuary practices that they may have followed, find their corroboration, direct or indirect, in the *Ṛgveda*[30] (*X.14-19*) in general and the later Vedic literature[31] (*YV*.XIX.36-37,49-70; *AV.*XVIII; *VS.*XXXV;*ŚB* II.4.2, II.6.1, XIII.8.1-4)in particular. While the *ṚV*, as has been widely accepted, belongs to the copper-bronze age, the bulk of the later Vedic literature was, admittedly, collected, enlarged and arranged during the early Iron Age yet it is remarkable for retaining old traditions of early times. It will be in fitness of the things to briefly touch upon them without dwelling on in greater details. There is no gainsaying that high and hemispherical monuments of Dholavira are highly evocative both in form and layout: the form may symbolize the womb of Mother Earth and the layout the eternity of time represented by the wheel of the solar car.

Going further back, the *Maitrāyaṇī-saṁhitā*[32](3.4.7),*Taittīriya-saṁhitā*[33] (V. 4.11) and*Śatapatha-brāhmaṇa*[34](VI.7.2.8)inter alia speaks of *ratha-chakra-chiti that*is an altar formed like a chariot-wheels do the later *Śulba-sūtras* of *Baudhāyana*[35] (V.16.&VII.18.), *Āpastamba*[36](XIII.1-7), *Kātyāyana*[37](IV.1) and *Mānava*[38](VII.1-7). *Baudhāyana*[39] (V.2-3, read with VII.18) tells about its two variants, i.e.*sapradhi ratha-chakra-chiti*, and *sāraratha-chakra chiti*, respectively suggesting 'an altar (designed like a) chariot wheel with (segments of)a felly or rim (only)' and the other with 'spokes' (as well). Acharya, a great authority on Indian architecture, has discussed and also reconstructed the spoked-wheel type of altar on the basis of ancient treatises[40](Acharya 1979:63,393 pl. xxa, iii). His drawing shows five courses of bricks of the altar (Fig. 2).He also adds that its height can be increased in the multiples of five; say ten, fifteen courses, and so

on as detailed byĀpastamba[41] (*Śulba-Praśna* X.18.28) as per the status of the sacrificer earned by the number of times one has performed such *yajñas*. It is notable that the above-mentioned reconstruction implies a cylindrical form. It may assume a domical top only if earth is piled up over it. The very concept of wheel, with or without spokes, seems to be highly symbolical. It should not be out of place to find out the origins of it.

9.4.7.4 Symbolism behind wheel

The concept and symbol of wheel (*chakra*) was not new, albeit it found a new connotation in the Buddhist thought, art and architecture. This symbolism may be traced back to the *ṚV.*It is subsequently as well repeated in the later *Vedic* texts, the *Mahābhārata*, the *Purāṇas* and so on. In *ṚV,* which is the earliest of the Vedas and also the most ancient literary composition in India, it is inter alia a solar symbol and as such also represents a year, i.e. *saṁvatsara* or ś*arad* and its various components like felly, spokes, hub, axle and axle-hole, all signifying different time-units. A *saṁvatsara* symbolizes, often referred to as the wheel of time (*saṁvatsarakāla-chakra)*, fitted to the chariot of sun-godin a hymn *ṚV*[42] (I.164.*Anukramaṇikā)* which is most copious in allegorical imagery flicking through cinematographically.

In this respect, twelve segments (*pradhis)* of fellystand for as many months, three naves, for three main seasons of four months each, 360 pins(*śaṅkus)* for as many days[43] (I.164.48*)*, ortwelve spokes(*dvādaśāra-chakra*)as well for as many months altogether having 720 children in pairs standing for as many pairs of days and nights[44](I.164.11*)*. One verse[45](I.164.12*)*speaks of seven circles and six spokes*(sapta-chakra şadara)*, the former are seven (concentric) circles in the felly and the latter for six seasons of two months each. Seven are the rays, figuratively called seven reins or seven steeds[46] (I.105.9, I.164.2-3). The never-decaying solar wheel with a rim is also said to be attached with ten[47] (I.164.14), perhaps indicating directions. If the wheel has three spokes (*tryara-chakra)* each standing for three seasons of four months each.

All these metaphorical imageries of a time-wheel invariably pertain to the chariot of the sun-god[48] (*Ṛ*V.I.164; IV.17.14; V.31.11; VII.63.2, etc.).A few verses of the hymn under reference are particularly highly significant as those somehow are related to death as well as afterlife and immortality of the living essence (*jīva*) of the deceased that is firm in the midst of its abodes (i.e. perhaps cemetery) and moves immortal by its own energies (i.e. drawn from the offerings made by its mortal descendant).[49] (*Ṛ*V.I.164.30). Equally significant is another verse[50] (I.164.12) (partly referred to above also) which talks about the deity as a parent *(pitṛ)* who is 'five-footed and twelve-formed' 'when in the further hemisphere of the sky' 'shining in his seven-wheeled (car), each (wheel) having six spokes' obviously describing the sun-god[51] (Wilson 1977:107). The sun, which is the most bright luminary, universal timekeeper, life-giving energy, tireless traveller, never-decaying light, hence an exquisite symbol of life, motion, renewal and immortality, and its wheel symbolizing the sun itself, its eternal gyration and energy, thus representing a year, time and eternity, was, therefore, an appropriate form for the fire-altar (*agni-chit/chiti*) as well as a funerary altar (*śmaśāna-chit/chiti).*

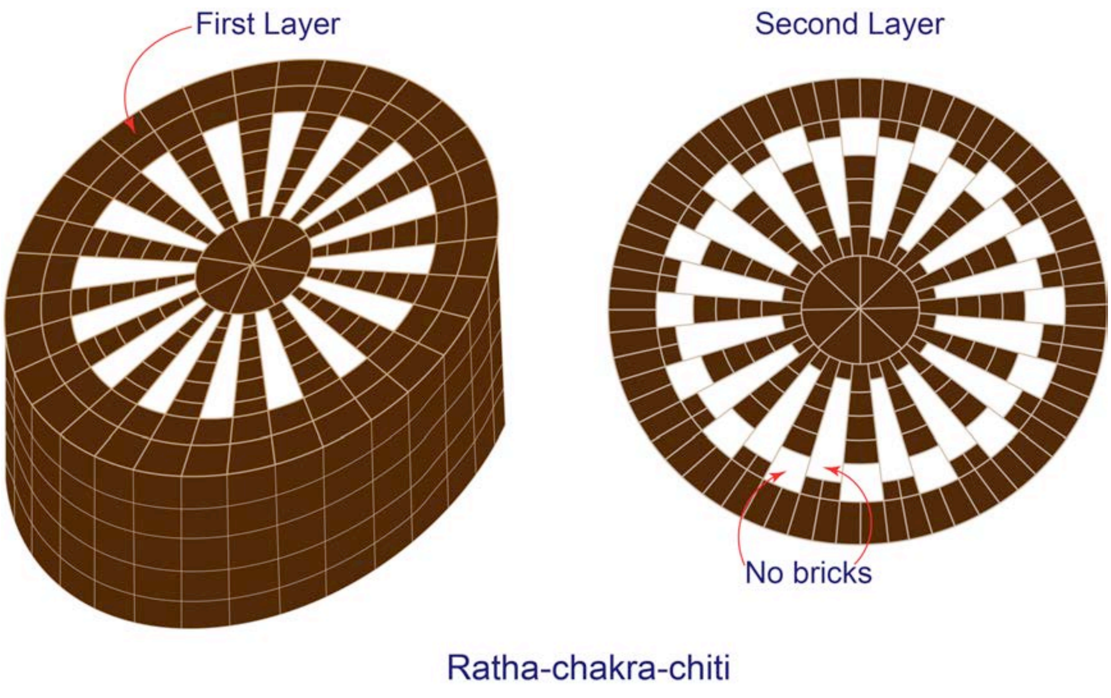


Fig. 9.17: Details of *ratha-chakra-chiti* in literature

In support, it should be worthwhile to refer to the prescription that a *śmaśāna-chiti* for a special class of ancestors is to be made in the form of an*agni-chit*[52](*ŚB* XIII.8.1.1.17). The same spirit seems to be prevailing in *Maitrāyaṇī-saṁhitā* which juxtaposes both together while prescribing for placing a piece of gold[53](III.2.6)on the ground before either of the altars is to be built. We believe that all types of altars used for sacrifices may have been replicated for funerary altars per se monuments depending on the social and ritual-related status of the deceased.

Without implying any contemporaneity and identification between the later Vedic Aryans and the Harappans, we hold that both the Dholavira Tumuli-1 and 2 are, perhaps, the just right examples of the two types, viz. an altar simulating a chariot-wheel with spokes or one with segments of the felly only, as cited above. Furthermore, it may be recalled that we have suggested two alternatives regarding the probable nature of the rise of both the sepulchral monuments which have been investigated at Dholavira. It may not be improbable that originally the platform as well as the wheel surmounting it had a vertically cylindrical elevation and the earth piled over it finally rendered it a domical top, almost in the manner in which most of the Buddhist stupas ware made, and centuries of erosion have given a hemispherical form as if rising from the ground.

Or else, the practice of providing a platform along with or without wheel upon it with a vertical elevation was a later innovation. It will be relevant to note that a large hemispherical monument is an elaborated form of a circular cairn which rises from the ground itself and examples of which are seen from the Harappan Dholavira to the Megalithic. It may be one among several other innovations and contributions which the Harappan bequeathed to the posterity, and at the hands of the Buddhists it received exquisite elaboration and embellishment as manifest in the Sanchi stupa. In the light of this may be viewed both the monuments of Dholavira regarding which we have already discussed above at relevant places.

9.4.7.5 Miscellaneous mores in the literature

Since funerary practice and perpetuation in memoriam in any society form always a very solemn tradition which is not easily changed and given up. In case there is a plurality of such mores or modes prevailing concurrently in a society it indicates towards comingling of different social strands to make a larger society and this is precisely what we see in the Harappan world, as best evident at Dholavira in this context. It should not be out of place to find out whether the ancient literature can throw light on the subject so as to help interpret what we are finding in Harappan context now. It, therefore, seems relevant to take recourse to the *Ṛ̣V.* and the subsequent texts of the genre.

In Ṛ*V.* there is a special class of priests called Yāmāyana, obviously derived from Yama, the god of death, who was incidentally the elder son of Vivasvat, the sun-god, and, the first mortal (to go south) to die[54] (*ṚV* X.14.1-2), (the southern quarter hence belonging to him). The hymns from 14-19 in Xth Maṇḍala are entirely funerary in nature. While the first among them is ascribed to Yama himself, the rest of the hymns are credited to the Yāmāyana priests. Most of the verses of the group have been picked up from *ṚV* and placed in*Yajurveda*[55] *(YV*19.36-70),*Atharveda*[56]*(AV* 18.1-4), etc. although those are arranged differently, even by changing words or parts of a verse and even some new verses have been added, particularly in the latter. Many of them have also been freely employed in the latter *Saṁhitās* and *Brāhmaṇas* in connection with mortuary rites.

Broadly speaking, *ṚV*[57] *(*X.15.14)(and others-*AV* 18.2.35) points towards two basic modes of disposal of the dead: the first, those who were consigned to the fire (*agnidagdha*), and the second, those not consigned to the fire (*anagnidagdha)*.The formeris also called *agniṣvātta*in the text[58]*(*X.15.11; *AV* 18.3.44),and, later, in contrast the term*anagniṣvātta*is coined subsequently[59] (*YV.*19.60). Obviously, both, the modes, viz. cremation andnon-cremation, were in vogue in the society, although those, especially the latter, require proper further defining and in this regard, too, the text provides some useful information as it speaks of the manes those seated in the cases (perhaps, coffins)[60] (X.15.5)

of, or upon a spread of, *barhis* grass[61] (X.15.3-4, etc.), or seated in (pottery) jars[62] (X.15.9-10), or lying (in their graves) on their right side by drawing up (their) legs[63](X.15.6), certainly in crouched position like a foetus in the womb of mother. Examples, particularly the last two, can be seen all through the chalcolithic periods in Baluchistan, some even from the Neolithic times with a little variance. One hymn, which has been referred to and discussed umpteen times by scholars, expressly speaks about interment of a dead person (in the grave)[64] (X.18.7-9). It is interesting to show that the dead person was placed in the grave along with his wife and a bow and an arrow in hands. Both the objects were taken back and his brother pulls out the wife. The same hymn speaks of piling of earth[65] (X.18.10-12) and erecting a pillar[66] (X.18.13) on the top or by the side of tumulus and finally putting around (a ring of stones) as a boundary between the living and the dead[67] (X.18.4). Elsewhere, someone implores Varuṇa not letting him to go into the house of earth, obviously the grave.

Atharveda[68](XVIII.2.34) is more specific in averring four methods of disposal of dead, viz. *nikhāta*, *paropta, dagdha* and *uddhita*. *Nikhāta* certainly points to burying the body or relics in a grave dug in the ground. The term *paropta* is considered as 'cast away' by Sāyaṇa[69] (Gupta 1972:161). But, etymologically, it is formed of *para* or*parā*+ √*vap*+past form, meaning something uprooted from one place and transplanted at another, hence importing exhuming of a buried body (after a considerable period of time when the perishable parts are completely de-composed and the residual skeleton) and giving it to secondary burial at elsewhere. It perhaps points per se to fractional burial as well. *Dagdha* is unambiguously cremation. *Uddhita*, however, posesa problem. It appears to suggest exposure of the dead body to the elements by way of keeping it on a higher place or on some such thing like a tree for carnivorous animals, birds and insects to feed on. This issue is discussed further by Gupta[70] (1972:160-67).

To explain the presence of pottery, in many cases in a large number it is well-nigh accepted that those were meant for offering viands to the dead. In this regard reference is to be made to the offerings of cake, milk, curd, ghee, meat, juices, honey, other eatables, some mixed with sesame seeds and so on kept in

covered pots*(kuṁbhas*), besides mentioning some specific pottery forms, all in connection with *pitṛmedha*[71](*AV.*XVIII.4.16-30).

Śatapatha-brāhmaṇa informs that the godly people (meaning the Āryas) make quadrilateral burial places while 'the Asura people, the easterners and others'[72] (Eggeling 2002:423-24) make them round[73] (XIII.8.1.5)and further adds that a sepulchre should be of man's size and not too large and yet prescribes the dimension of the mound differently for each class of people such as 'for a kṣatriya as high as a man with up stretched arms, for a brāhmaṇa reaching upto the mouth, for a woman upto the hips, a vaiśya upto the thighs for a śudra up to the knee'[74] (XIII.8.3.11). All these appear to be cinerary monuments as it speaks of arranging the dead man limb by limb[75] (XIII.8.3.5, cf VS.XXXV.8-9) or pouring him out into (the grave a jarful of bones)[76] (XIII.8.3.1).Interestingly, it rules that the earth be cut out to the extent one intends to raise the tumulus and yet insists that it should be ofman's size[77] (XIII.8.1.20) as told earlier, too. While speaking about funerary altar Āpastamba says that it could be either quadrilateral or circular without making any mention of Āryas or non-Āryas[78] (XIV.10-11). Before closing this account it is necessary to state that all the description concerning altars is about the construction over the ground whereas a grave is under the ground. And also that much of the literature was written several centuries later yet, many types of the altars appear to replicate the underground features over the ground with the passage of time.

All that stated above is only to show that there was a plurality of modes of disposal of dead as well as sepulchral monuments in the ancient literature and there was also an elaborate system of funerary rituals which were repeated year after year to please the deceased ancestors for the sake of well-being of the living. A good deal of information that is contained in the ancient texts is not discussed here as that is outside the purview of this writing. It is, however, the need of hour that the archaeologists ought not to shy away from invoking the literature which holds promise of providing flesh and blood to dry skeleton of archaeology. Such details help one deal with exposure of funerary architecture, carefully collect the data, and try to understand the mind and method of the builders and to study it scientifically as well as in the light of the literature. Need

not to say that Indians have very conservative and methodical in performances of rituals. On the other hand, when the different forms of the funerary architecture of the Harappans at Dholavira are assessed it may easily be seen that the Megalithic tombs and the Buddhist and the *Jaina* stupas had their roots steeped, at least, in the 3rdmillennium BCE and are very much present at home. Also that the Harappans of Dholavira had, by and large, switched over almost largely to a different mode of disposal, most certainly cremation. It is therefore, natural that the monument they raised were memorials, most frequently furnished with offerings, although the examples of inhumation, fractional burial and burial of ashes are met with sporadically. This how the Harappans honoured death and left a rich tradition behind.

9.5 Discussion

The Dholavira excavation has thus offered not only some unique mortuary monuments but also much scope for debate in terms of diversity in ethnic composition, religious belief systems and structural forms and also to find as to what legacy the Harappans must have left for the later times.

Insofar as ethnicity is concerned it has generally been accepted now that the Harappan society was not a monolithic structure as was believed by the earlier scholars like Wheeler and Piggott. It seems that they were over awed by the abiding uniformity of the civilization and saw in it a ‘dead monotony’. It is indeed and overstatement. Under its overriding uniformity there were many regional manifestations at substratum level. These are best reflected in the ceramic corpus, terracotta art, quantitative as well as qualitative differences in a number of sundry things, and also in their belief systems.

It is but natural because there were many regional cultures flourishing in different parts all of which subsequently came under the umbrella of Harappanism (if I am permitted to coin this term especially for the classical form of the civilization, and likewise Harappania for the territory which came under it). As soon as the unifying forces weakened and broke down the regional elements which had been persisted along came up to the fore. Plausibly, Kachchh made a distinct socio-religious group as reflected in many items of its cultural milieu, and

in a big way in its sepulchral architecture although, it is admitted, some features are common to those in the other Harappan cemeteries and such features seem to be governed by common canonical prescriptions which the Harappans honoured. Among other things Dholavira stands apart in their funerary monuments and practices.

One of the glaring features at Dholavira is that the practice of inhumation and fractional burial is rather exceptional. The large majority of the grave-like structures, including the monuments, are memorials which usually do contain the grave goods, but no bodily remains. These goods, in most cases, are clustered, usually not conforming to any arrangement, but for in a single sepulchre in which, as already stated, there are found three sets of offerings made on as many occasions and in each set there is found an orderly arrangement of the goods. There is no evidence to show that there was performed any ritual rites inside the grave while placing the offerings. The very nature of the placement of the grave-goods suggests that those were the utensils and wherewithal of the ritual ceremony that was performed outside the grave. Such a ceremony may be likened to the traditional Indian *srāddha,* i.e. *pitṛ-yajña*or*pitṛmedha-yajña,* which is held during the first eleven days as well as on the first anniversary of someone's death, but not in the house, nor at the site of cremation or burial, but on the bank of a flowing water or a lake in which the ritual leftover, including the viands, are finally submerged and usable articles of value are given to the ministrant priest. It appears that the offerings that are usually found in the graves at Dholavira are the residue of such a ritual ceremony which was held elsewhere, away from the site of cremation or burial, and then given an honourable interment in the memorial monument. Since the relation of a water body with such a ceremony is essential, the location of the Dholavira cemetery on the banks of the channels is significant. More significant is the fact that the Harappan created thereabouts an artificial lake which was otherwise useful for storing the rain water.

A wide range of forms of funerary monuments, particularly the cist, cairn, cist in cairn, a circle or part of it containing single or multiple graves, built-up grave structures of different forms and orientation, deserve a fresh in-depth study

in the light of what the ancient literature contains as has been seen in the foregoing paragraphs in the context of the hemispherical monuments.

Furthermore, the variety of tombs which Dholavira has provided strongly reminds one of some of the types of the funerary architecture of Megalithic culture of the Iron Age datable from the first millennium BCE to early centuries of CE. There has been a continuing debate as to where the roots of the Indian Megalithic tradition lie. In most cases, the scholars look outside India, e.g. Arabia. We feel that we are not off the mark if we hold that the fresh evidence most probably show that the roots may not be searched elsewhere, outside India, but be looked at here, at home, per se Dholavira where their antiquity goes back in time to the third millennium BCE at least. However, there has been a long tradition of making sepulchres going further back to the Neolithic times of the 8^{th}-7^{th} millennium BCE, albeit with continual changes and variance. Now only missing links are to be found fore and aft the times that intervened between the Megalithic and Harappan periods.

We do not know as to what was the normal way of the disposal of the dead by the Harappans of Dholavira in the light of marked absence of skeletons or ashes in the funerary monuments. The two skeletons and some fractional burials in the necropolis are rather exceptions. The norm should have been different, may be cremation, exposure to the elements, or immersion in the water. In such a situation one is naturally tempted to assume that the Harappans, particularly in Kachchh, had entertained different religious ideology in some of the spheres of social mores. Practice of inhumation as a general norm of disposal is still prevalent in the Hindu society in certain regions in the present-day India. Besides, in case of a *sanyāsin,* a leper and an infant there is inhumation always even though the entire society cremates the dead.

9.12 Notes & References

1. Bisht 1991:71-82;1997:107–120;1999:14-37;2000:11–23; 2001:26-28; 2005 :11-25
2. Wheeler 1946:85-90; Dales et al 1991:206:12
3. Rao 1979:137-69
4. Sharma 1999:17-98
5. IAR 1954-55:9; Sharma 1956:123

6. Mackay 1976:252-63
7. Nath 1998: 41-43
8. Shinde *et al* 2008:64-78
9. Gupta 1972:70
10. Joshi 1990:364-71
11. Marshall 1931:79-87; Mackay 1937-38:49,94-95,116-18, 648; Dales 1968b:61
12. Singh 1900; Gupta 1972; Possehl 2002:157-76; Hemphill et al 1991:137-82
13. Vats 1940:221-45
14. IAR 1958-59:19
15. IAR 1970-71:7-8
16. Sali 1986:175
17. Sharma *et al* 2006:166-79
18. Kumar 2006:196-204
19. Srivastava 1991: 26-27; Laursen 2010:131-32, 134
20. Srivastava 1991:14-15
21. Laursen 2010:117-22
22. Srivastava 1991:45-182
23. Laursen 2010:120)
24. Srivastava, *ibid*
25. Srivastava 1991:99, fig. 18
26. Srivastava 1991: 14
27. Laursen 2010: 120
28. Respective plate no. VIII b, XVI a, and Xxa vide Srivastava 1991
29. Laursen 2010:120
30. *ṚgvedaX.14-19*
31. *YV*.XIX.36-37,49-70; *AV*.XVIII; *VS*.XXXV;*ŚB* II.4.2, II.6.1, XIII.8.1-4
32. *Maitrāyaṇī-saṁhitā* 3.4.7.
33. *Taittīriya-saṁhitā* V. 4. 11)
34. *Śatapatha-brāhmaṇa*VI.7.2.8
35. *Baudhāyana*V.16. & VII.18.
36. *Āpastamba*XIII.1-7
37. *Kātyāyana* IV.1
38. *Mānava*VII.1-7
39. *Baudhāyana*V.2-3, read with VII.18
40. Acharya 1979:63,393 pl. xxa, iii
41. Āpastamba*Śulba-Praśna* X.18.28
42. *ṚV* I.164.*Anukramaṇikā*
43. *ṚV* I.164.48
44. *ṚV* I.164.11

45. *Ṛ*VI.164.12

46. *Ṛ*VI.105.9, I.164.2-3

47. *Ṛ*VI.164.14)

48. *Ṛ*V.I.164; IV.17.14; V.31.11; VII.63.2, etc.

49. *Ṛ*V.I.164.30

50. *Ṛ*VI.164.12

51. Wilson 1977:107

52. *ŚB* XIII.8.1.1.17

53. *Maitrāyaṇī-saṁhitā*III.2.6

54. *ṚV* X.14.1-2

55. *YV* 19.36-70

56. *AV* 18.1-4

57. *ṚV* X.15.14and others- *AV* 18.2.35

58. *ṚV*X.15.11; *AV* 18.3.44

59. *YV.* 19.60

60. *ṚV*X.15.5

61. *ṚVX.15.3*-4, etc.

62. *ṚV*X.15.9-10

63. *ṚV*X.15.6

64. *ṚV*X.18.7-9

65. *ṚV*X.18.10-12

66. *ṚV*X.18.13

67. *ṚV*X.18.4

68. *Atharveda* XVIII.2.34

69. Gupta 1972:161

70. Gupta 1972:160-67

71. *AV.*XVIII.4.16-30

72. Eggeling 2002:423-24

73. *Śatapatha-brāhmaṇa* XIII.8.1.5

74. *ŚB* XIII.8.3.11

75. *ŚB* XIII.8.3.5, cf VS.XXXV.8-9

76. *ŚB* XIII.8.3.1

77. *ŚB* XIII.8.1.20

78. *ŚB*XIV.10-11

Chapter 10

Trade and Outside Contacts

10.1 Introduction

Close on the heels of its discovery in the early twenties of the previous century, it had become immediately obvious that the Harappans' was a highly advanced urban civilization, that it had established firm trade relations with its contemporaries of the 3^{rd} millennium BCE in the western world of Mesopotamia and Elam, and further that the mode of contacts was rather predominantly maritime. What looks striking in hindsight, even after nine decades of intense research, is the suddenness and briskness that mark the strength of mercantile activities which are manifest in the presence of tangible objects of the Harappan origin on the other side, however, knowing little of what would have been intangible wares in transaction. Besides, it is not yet much clear as what was the maritime experience of covering long distances on the part of the predecessors of the Harappans. It is, however, in evidence that the history of exploitation of marine resources steeped in antiquity as we shall touch upon it later. In the meantime, it may be noted that, from the westernmost Harappan outpost at Sutkagen-dor to the Mesopotamian shores, there lies more than 700 nautical miles (c. 1300 km, inclusive of c. 615 km of the Arabian Sea and c. 720 of the Persian Gulf) of vast expanse of waters which is bordered by Iran on the north and by the Arab states of Oman, United Arab Emirates (U. A. E), Qatar, Bahrain, Saudi Arabia and Kuwait on the south and the west. It may, therefore, be pertinent to know about those lands in order to understand whether their ancient inhabitants of those lands could have shared their experiences of navigating the sea and the Gulf with the Harappans. Archaeologically speaking, a good deal of work has been done in the south-eastern Iran and in the hinterland, albeit the rest of the northern seaboard is poorly surveyed, but, on the other side, i.e. in the Arab states, there has been conducted an appreciable amount of field

research in recent decades.

To say in brief at the outset, man's acquaintance with the sea should go back to very remote times when he was wandering wild in a group along coastal areas to considerably subsist on seafood. It was but natural for him to have developed, in course of time, a skill to swim and dive to catch the kill much before he learnt the technique of braving waters for some distance by using a floating driftwood and making his hands as paddles; and later making a raft of reed or twigs and grass that facilitated him more to go farther and stay longer in water for a better harvest would have come in sequel. Some groups of humans may have learnt to make a dug- out by scooping tree-trunks. That was how they crossed straits to spread out widely in different islands and continents in the world.

In this context, we may revert to the land of Oman and the Persian Gulf as it was largely the land which lies nearly halfway between India (South Asia) and Iraq (Mesopotamia), and it would not only serve later as the corridor but also a partner in the external trade and commerce of the Harappan seafarers and merchants. Furthermore, the seaways were the only feasible means of approach available to the Indus entrepreneurs to reach out to the ancient peoples of Oman, the Gulf lands and distant Sumer. In order to trace the history of oceanic contacts, howsoever tentative and fragile that could be, we shall have to look back in the past. Now, it is well-nigh believed, on the bases of archaeological records and new scientific findings, that the humans of the Early and Middle Pleistocene, while moving out of their east African home (Tanzania, Kenya, Uganda, Ethiopia) crossed the Red Sea, probably through narrow land bridges (and partly by wading through the waters), and got widely spread out over the Arabian peninsula and the Mediterranean Levant by about at least half a million years ago (Cleuziou et al. 2007:19-31, fig. 13) before dispersing further northwards and sideways. Later, from about 150,000 years ago, their evolved successors. Homo sapiens, appeared on the scene during the Late Pleistocene, as better equipped hunters and foragers, and

made a strong bid to people all the continents. In course of their outward march, they braved the waters to reach the Malay Archipelago and, around 60,000 years ago, entered Australia (Cleuziou et al. 2007: 35-58), arrived the British Isles, and, some 30,000 years ago, crossed over to America (through the Bering Strait).

Around the Middle Holocene, say from the 6th to 4th millennium BCE, there came about ‘The Great Transformation’ characterized by the ‘sub – Neolithic’ subsistence economy, that was characterized by seasonal settlements of dwellings, series of burials, herding of cattle, sheep and goats and extensive harnessing of marine fauna, the last-mentioned one being represented by what the archaeologists call ‘shell midden’ sites which dot the Indo – Pacific coastlands (Cleuziou et al. 2007:61-97), the north and east Africa (Steward 1989), the eastern Arabian seaboard (Cleuziou et al. 2007: 65-70, figs. 44,72), the Arabian shores of the Gulf (Vogt 199-4:113-128, figs. 9.1 & 9.2) and the Indian Makran coast (Desse et al. 2001 : 86-92). There is, however, a striking difference in the nature of the middens of the eastern seaboard from those of the Gulf shores. While those of the former are a ceramic in nature, those of the Gulf form two groups: one, those which are a ceramic and are, by and large, earlier in date than the second group of sites which are usually found mixed with a sprinkling of potsherds of Sumerian origin, belonging to the Ubaid period, ranging in time from the late 6th to the 4th millennium BCE. These sherds are supposed to have been dropped there by Sumerian sailors as there is no evidence of local manufacture of pottery, metal objects or craft things of value whatsoever. Naturally as such, the Sumerian contact, howsoever tenuous it was, did not bring about any qualitative change in the primitive lifestyle of those Stone Age foragers and fishermen of the Gulf. The Sumerian sailors were, perhaps, seasonally visiting their poor contemporaries for collecting from them dry fish, fish oil, shark skins, shells and probably some jungle produce in exchange for food grains and fabrics. On the contrary, what is the most important in the midden sites of the eastern Arabia, e.g. Ra´s al- Hamra site RH5 in Qurum, near Muscat

(Oman), which is far better surveyed and investigated and marked by the presence of bones of scombridae, shark and tuna of large and medium size requiring some kind of watercraft to go to the deep water for a catch. Cleuziou and Tosi (2007:74) hold that boats, ‘much like those used in recent years’ in Oman, ‘were built from reeds, stalks or small branches, like shasha boats.’

Coming to South Asia, there too are found scatters of shells and fish bones which are reported from the Makran coast. The explorers have noticed there several midden sites, ranging in time from the late 4th millennium BCE to the Islamic period; like those of the Gulf, these sites contain shells and fish – bones of those which primarily thrived in shallow water environment instead of being in offshore deep waters, thus foreclosing use of water crafts of any worth on the Indian side (Desse et al. 2001:86-92). It is, however, admitted, that the Indian seaboard is not at all adequately investigated from the point of view we are here concerned with.

In fact the history of fish-eating communities along the seashore was, perhaps, a long-drawn affair because the anonymous Greek author of *The Periplus of the Erythranean Sea*, while setting off from the Egyptian harbour of Mussel on the Red sea, noticed several groups of such savage people, whom he calls Ichthyophagi, meaning fish-eating people, living in seclusion along the coasts of the Red Sea, Arabian shores and islands as late as the early centuries of Common Era (Schoff 1974 : 22,23,29,35, 56, 143 , 146). A segment of the Peutinger Tables, almost the contemporary of *The Periplus,* shows the Ichthyophagi as well living on the Makran coast alongside of the people of Gedrosia (Besenval 2011:fig 32). This is further corroborated by the account given by Nearchus, the admiral of Alexander the Great, that “the Greek fleet, sailing along this shore in 325 BC from the mouth of the Indus to Persia, strongly increased the very bad image of coastal Gedrosia where one could only see poor and few human groups living – or in fact surviving – only on fish and shells” (Desse et al. 2001: 86)

Those, whom the author of the *Periplus* found surviving along the African and Arabian coasts ,and the Peutinger Table shows them on the Makran shore should have been the poor remnants of those ancient people who had left out from the cultural mainstream, possibly as early as the third-second millennia BCE, while the more enterprising of them may have slowly and gradually joined hands with civilized communities to become expert sailors, navigators, boat-makers and shipbuilders during the 4^{th} - 3^{rd} millennium BCE . The Koli community (or even those known by some other group - names in different regions), living by the sea

From Makran to Kerala in India may be the descendants of the ancient fishermen who ably provided their services and expertise to the Harappan merchants and shipping magnets. ‘Navigation and port finding were the skills which depended on the accumulated knowledge of generations of fishermen, sailors and astronomers’ who were familiar with the phenomenon and features of sea, its shoal and reef, its depth, its currents, its bird life and sea life, changing patterns of wind, landmarks and seaboard’ (Cleuziou et al. 2007; 207).

When it comes to the exploitation of marine resources in India, it goes back to the time of the dawn of the sedentary way of life, ascribable to the late 8^{th} or early 7^{th} millennium BCE, in the north-western part of the subcontinent, as emphatically testified at the site of Mehrgarh (Balochistan, Pakistan), where there had been used amazingly as many as fifteen species of shell for making jewellery for personal decoration (Kenoyer 1995:566-69), in addition, to an anthropomorphic figurine (most plausibly of a female divinity) cutout from a mother-of-pearl shell originating from source (Jarrige et al.2001:139, fig.10). The nearest source of these marine shells lies about 500 km away in the Arabian Sea, where those seem to have been collected from different environmental zones in the area extending from Karachi to Pasni along the Makran coast ((Kenoyer 1995:566-69). Significance of these marine shells get considerably enhanced in view of the presence of other exotic gemstones

such as lapis lazuli (lazurite) and turquoise, both being obtained from far away, the former from the famous Badakhshan mines in Afghanistan, 'discovered very long ago and described already by Marco Polo (1271)" (Betekhtin n.d.: 576), and the latter from the Madan deposit near Nishapur in Iran, or may be from Kara-Tyube, south of Samarkand (Betekhtin n.d. :419),thus both from long distances, suggesting a considerably wide networking on the part of the early Neolithic people of Balochistan. It is relevant here to state that the sea shells, once came into the cultural milieu in South Asia, stayed back in Indian culture as a sacred cult object or an essential jewellery item for all times to date. However, proceeding further back in time, we would like to refer to the presence of marine shells and bones in the context of Period II, i.e. the Miri culture, dated to the 1st half of the 4th millennium BCE, at Miri Qalat and Shahi Tump in the Kech-Makran region (onside of the Indian subcontinent) (Besenval 2011:49-51).Here, there are found whole-shell bangles, seashell necklaces (of Engina mendicaria and others), a mother- of pearl amulet and bivalve seashells filled with ochre (for colouring bodies perhaps!), besides saw shark rostrum and skate sting, mostly in the context of burials and sometimes otherwise (Besenval 2011:45-48, figs. 56, 58, 60, 63, 68, 70-72). Many of these shells may have necessitated deep-water fishing or diving by using boats. In the present context, the find of the mother-of-pearl pendant is, however, very significant in that it somewhat, if not precisely, resembles the aforesaid Mehrgarh figurine in material, form and technique of cutting, and also perhaps in its cult value. The Miri culture assemblage betrays a strong regionalism though, yet some pottery forms have been likened to those from the Iranian plateau and even Susiana. On the whole, there emerges a picture of efficient exploitation of the sea resources, with a possibility of using similar kinds of crafts, besides pointing to a wide sphere of interaction extending from the Kachi plain to the south-western part of Iran or even beyond.

In the Kech-Makran the following Period IIIA, designated as the Shahi Tump Cemetery culture, and ascribable from 3rd quarter of the 4th millennium to the

beginning of the 3rd BCE(Besenval 2011:45,49-51), is also important from our point of view as well as archaeologically and socio-economically. So far, no settlement of this period has been found so far, it is represented only by several rich graves. In our present study, apart from the proximity of the region to the Arabian Sea, the find of broad striped seashell bracelets which invoke close resemblance to the one worn by "The Lady of Sarazm" on her right wrist at Sarazm, that lies as distant as Zerafshan in Tadjikistan, is of special interest (Besenval 2011:50, fig.117-20) . It need not be at all surprising in view of the richness of the period under discussion as reflected in its yielding exotic lapis lazuli, pure gold and electrum, a range of compartmented seals, an impressive array of beautiful painted pottery and a "leopard weight" that is decorated with shell inlays.

This was the time around when there occurred at Ra´s al Hamra the first appearance of pottery in the form of 'an almost complete pot of burnished grey ware' and 'a few sherds', both being 'foreign products' in the temporal context of ca. 3400 BCE. The former was chemically analysed to have been imported from the south-eastern Iran and was being used for cooking bitumen. The bitumen, in turn, originated from central Mesopotamia, and was used 'for caulking of a fishing boat' (Cleuziou et al. 2007:87-88, fig. 64).In the words of Cleuziou and Tosi the ''south-eastern Iran was highly developed at this time, agriculture and metallurgy being in use since the 6th millennium BC, and there was certainly contacts across the sea between Oman and these regions. The Strait of Hormuz is less than 80 kilometres wide and the many islands of the eastern Gulf could facilitate its navigation". Thus during the second half of the 4th millennium BCE, there has appeared a contact, albeit feeble, that certainly involved crossing of a wide water body by no other means than a boat which was being rendered waterproof by applying natural tar. Now, we shall see how gradually the Arabian lands came closer to Iran, Indian Makran and Sumer.

10.2 Meluhha, Magan, Dilmun

The Mesopotamian cuneiform texts often mention three important foreign lands, viz. Dilmun/Tilumun, Magan (in Sumerian) or Makan (in Akkadian) and Meluhha, which were located in the "Lower Sea" (the Gulf) and beyond it, hence approached by a ship only. The above order of reference may be reversed, but it is fairly certain that Dilmun was the nearest and Meluhha the farthest while Magan lay between the two. This geographical order had, it appears, a time order too, in the sense that Dilmun came to be known to the Sumerians first and stayed the longest in contact, then followed Magan, while Meluhha came to be known later, although artifactual record originating from Meluhha were certainly from the preceding period, at least from Early Dynastic III A. There is the oft-repeated boast of Sargon of Akkad, the first emperor of Mesopotamia, saying "ships of Dilmun, ships of Makan, ships of Meluhha moor at the quayside of his city of Agade".

It has been widely accepted that the littoral extending from the island of Failaka in Kuwait to Qatar was the land of Dilmun that, of course, included the Saudi Arabian coast and its islands and the island State of Bahrain. It was only in the later times that Dilmun was identified more with Bahrain, which was gifted with artesian springs and gardens, and having havens for anchorage of ships, thus said to be a veritable paradise on earth.

So far as Magan is concerned, most scholars identify it with the mineral-rich Oman peninsula that comprises both U.A.E and the Sultanate of Oman. Some tend to include in it a part of the advanced south-eastern Iran as well. By going a step further it is not unlikely that the south-eastern Iran, together with Pakistani Makran, was the original Magan (Possehl 2002:220) to which the Oman peninsula got naturally included as and when the Iranians started spreading themselves out with the intent of obtaining the coveted copper, and their strong presence in Oman is best manifested in the widely spread Iranian pottery during the early half of the third

millennium BCE. This influence points to a situation in which Oman may have become a political protectorate or an economic colony of Iran in a manner it had been many times over during the historical times, although at times there was the role reversal too. Most significantly, further in this connection, there are epigraphic references to Maka (Makae) as one of the provinces of the Akhamenian Empire during the reign of Darius (c. 522-486 BCE) (Sircar 1965:5-7). Maka, most plausibly, stands for the Greek Gedrosia of which Makran was a part as has already been indicated earlier. There seems to be a connection in Makkan/Magan, >Maka >Makran, and the last-mentioned one being called so as to rhyme it with Iran, Turan, Kirman and so on. Archaeologically speaking, Makran was mostly oriented towards Iran (Besenval 2011:48, 51, 52), rather than to India, save for the times of the Harappan hegemony from c. 2500 to c. 2000 BCE (cf. Dales 1962:86-92; Besenval 2011:53-55) Thus, Magan may have been the south-eastern Iran and Makran, extendable to Oman, the last-mentioned one having some of its own cultural form that was without many of the other cultural trappings of Iran and Makran regions of course, ethnically and linguistically, Oman was always, as of today, completely different from Iran.

Meluhha has, perhaps rightly, been identified with the Harappan territory in the Greater Indus Valley and beyond, as it was the easternmost and farthest civilization which had brisk trade relations with Mesopotamia, and as the Harappan presence is duly attested in the intervening lands of Oman and the Gulf, and also as it possessed, or was in a position to provide, all what its affluent contemporaries of the valleys of the Euphrates and the Tigris wished to import (fig. 1).

10.3 Meluhha - the Harappania

The Harappan script remains undeciphered. The language, in which those inscriptions that are engraved on seals, tablets, tools, jewellery items, or in the Dholavira signboard, or in the Dholavira lintel inscription, is thus unknown. Obviously, the culture's relationship with the ancient most Indian literature, i.e. the

Ŗigvedic, or the Later Vedic, remains obscure and uncertain, and it is rather a controversial subject. There are thus, as of now, no written texts to fall back upon in its own homeland. In contrast, the contemporary Mesopotamia and Egypt have enough written records to build up history and conjure up the societies in perspective.

Significantly, in the cuneiform records of Mesopotamia, there are found the names of the three foreign maritime countries, one of them is Meluhha. Now that a strong consensus has developed among scholars to identify Meluhha with the Harappan territory (c.f. Possehl 2002:219), a meaningful discourse is, therefore, possible and worthwhile to briefly look to the west (and at home too) to find out the pointers to interaction between Harappania and Mesopotamia, howsoever meagre that be, although this subject has been well researched by a number of scholars. It is most relevant to recount that the find of the Indus seals in Mesopotamia and Susa provided Harappan civilization a chronological framework besides underlining the intimate relationship between the two.

There are three kinds of evidence to look for the interaction by the Harappans with the other maritime countries, including Mesopotamia--these are: 1. textual, 2. artifactual, and 3. architectural.

The first of them can only be found in the texts found in Mesopotamia; the second comprises a group of objects such as seals, sealings, beads, weights, ivory combs, pottery, chlorite/ steatite vessels and other miscellanea, which are found in Mesopotamia, Elam, the Gulf regions, the Oman peninsula or even in Harappania; and the third kind of evidence is not direct, it is rather indirect or implicit in nature in order to underscore the maritime character of the Harappans through such examples as the Lothal dock and the clay models of boats found thereat, boats on the Mohenjo-daro seals and possibility of Dholavira, Balakot, Sotka-koh and Sutkagen-dor being the ports on the international trade route of yore.

10.4 Textual evidence

Possehl (1996:138-45) has proferred sevety-six citations about Meluhha occurring in the inscriptional and lexical literature in the cuneiform records of Mesopotamia, covering the times from the Early Dynastic to the reign of Hammurabi. He has, in fact, mostly culled the information from an unpublished manuscript of Michael Nimtz of the University of Pennsylvania (n.d.) as well as from a paper of W. Heimpel (1987:22-91). In recent years, Kazuya Waekawa and Waka Mori (2011:245-69) have also dwell independentally on the original cuneiform texts, covering almost the same period, i.e. from the Early Dynastic III (c.2500-2350 BCE) to the Old Babylonian records (c.2000-1600 BCE). The latter, in fact, are scholstic, lexical texts which were written in the post-Sumerian (Old Babylonian) period when most of the international contacts have ceased to be, yet they contain much useful information that actually pertained to the Ur III period (Waekawa et al. 2011:245). The information given in the following paragraphs are mostly gleened from the above-mentioned writings.

10.4.1 Early Dynastic period (c.2500-2300 BCE)

Despite there being genuine artifactual evidences, there is, however, no explicit allusionto Meluhha in the contemporary texts, except for a reference from a later school text that is believed to have been copied from an original composition that says, 'Magan and Meluha submit to you', perhaps, addressed to a king or a diety (Possehl 1996:139)

10.4.2 The Akkadian period (c. 2300-2159 BCE)

An Old Akkadian cylinder seal depicts inter alia a translator of the Meluhha language. Further, a list of names in a Lagash record gives Meluhha as a personal name (Possehl 1996:139) Waekawa et al. (2011:248-49) cite a few administrative records mentioning that rations were given to the 'men of Meluhha ' who were to board the ship of Meluhha. An Akkadian inscription of king Rimush's time (c. 2249-2236 BCE) informs of how Meluhha came forward to join hands with the Iranian countries to fight against the king in which the latter eventually came out victorious (Waekawa et al. 2011:251) - indeed an interesting piece of information, if at all true.

10.4.3 Later compositions referring to possible Akkadian Meluhha

Several of later literary compositions provide references to possible Old Akkadian Meluhha. One of them is the famous account of the kings of Akkad in which the boastful claim of Sargon (c. 2300-2245 BCE), who carved out the first empire by unifying the south and north Mesopotamia, is said to proclaim:

> The ships from Meluhha,
> the ships from Magan,
> the ships from Dilmun,
> He made tie up alongside the quay of Akkad

[The above is the Kramer's translation as taken from Possehl (1996:133)].

Another inscription also speaks of the ships of Dilmun, Magan and Meluhha (Possehl 1996:139). In the "Legend of Naram-Sin", Sargon of Akkad is credited with the conquest of Dilmun, Magan and Meluhha--of course seems to be an exaggeration so far as faraway Meluhha is concerned. "The Curse of Agade" alludes to the 'Meluhhan people of black mountains' who brought exotic ware down to her, while another citation talks of the 'bridge of Baza on the edge of the road to the land of Meluhha'. (Possehl 1996:139)

10.4.4 Gudea (c. 2090 BCE) inscriptions

Several inscriptions of Gudea advert the imports from Meluhha : three of them that of wood; one, that of gold dust; another one that of gold dust together with refined silver and carnelian; and yet another, that of copper, tin, slabs of lapiz lazuli, refined silver and pure carnelian (Possehl 1996:148). Thus the imports from Meluhha are wood, gold dust, silver, copper, tin, pure carnelian and lapiz lazuli. A Gudea inscription says, 'Magan and Meluhha in their mountains / loaded wood upon their shoulders for him / and gathered, to build Ningirsu's house / to Gudea to his city of Girsu'. (Possehl 1996:140)

One citation makes Meluhha as a personal name, while other one refers to a man engaged with a ship of Meluhhan type (Possehl 1996:141)

10.4.5 Ur III (c. 2100-1989 BCE) economic texts

Several economic texts of the Ur III period(Possehl:141-42) refer to Meluhha in the context of the import of metals and wood, and objects made of them, besides there are a few other advertments just bearing on economy in a general sense. One text mentions the import from Meluhha of tin, copper, old objects of copper and bronze; a good number of texts spell out some species of wood of Meluhha such as gis-ab-ba wood used for fashioning sheaths, or for a seat with gold-plating, or a weapon to be gold-plated, or a weapon with sheaths; or mêsu wood for making one piece of a high seat, or a sheath made out of a spare part of wood, or one piece of a 'joined' stool, or a stool made out of a broken top of a bed. It shows that Meluhhan wood was a regular item of export and used for making a variety of furniture, or even old material was reused to benefit. The Meluhhan ivory was used for different purposes, like three *mana* of it was cut for crafting one small male figure, three small female figures and one bird ; or for making a sheath; or (again) for fashioning figures of a male and a female.

Further, at least at three places Meluhha was used as a personal name: six persons were engaged by an official named Meluhha (Possehl 1996:142). The use of Meluhha as a personal name seems to be a general term or for a Meluhhan who had come for business or had settled in Mesopotamian land. But there is also referred to Urkal as a son of Meluhha, who received a ration of grain (Possehl 1996:142).

One text avers 'the Meluhha garden of Ninmar', elsewhere about Nin-ana from the village of Meluhha, or about the granary of the village Meluhha, (Possehl 1996:142) Further, a later copy of a royal inscription of the last Ur III king Ibbi-Sin's time (c. 2013-1989 BCE) records the receipt of a 'speckled dog of Meluhha' as a tribute from Marhashi--the beast could have been a leopard (Waekawa et al.2011:251; Possehl 1996 :143), or a spotted dog itself.

‘There is no concrete evidence that ships of Meluhha came to southern Mesopotamia in the Ur III period, this lack of evidence stands in stark contrast to the

preceding Akkadian period' (Waekawa et al. 2011:253). Immediately thereafter, it is quoted from a Lagash record of Ur III period that has been translated as a 'grain-depot of a village of Meluhha', perhaps the same which has already been mentioned as a granary. Furthermore, 'After Ur III period', infact, 'the Mesopotamian merchants ceased transferring at the ports in Magan, and the maritime trade was again carried via Dilmun' (Waekawa et al.2011:258).

10.4.6 Old Babylonian (Early second millenium BCE) references to Meluhha

In fact, as stated by Waekawa and Mori (2011:258), the post - Sumerian administrative records do not mention Magan and Meluhha to be partners in overseas trade and the Mesopotamian merchants of the Ur III period had stopped transferring wares at the ports of Magan, and were rather purchasing exotic products in Dilmun which seems to have emerged as a trading entrepôt. Yet, the scholastic texts, written in the Sumerian language (while the spoken and administrative language was then Akkadian) and composed during the Old Babylonian period (c. 2000-1600 BCE), provide useful insight into the times of the preceding third millennium BCE through their several literary and lexical compositions, some of which are: *Curse of Agade(CoA);Enki and Ninhursag (E&N); Enki and the World Order (EWO); and Enlil and Ninlil--all* those which provide mostly direct references to Meluhha or in one case only some inferential information. These are, by and large, based on older literature which was revised and upgraded for the use of schoolboys (Michalowski 2001:454). These works however, provide much information, including about foreign lands and their products--the kind of 'details that are seldom revealed in the third millennium administrative documents' (Waekawa et al.2011:259).

CoA defines Meluhha to be a country of black mountains--an expression which finds mention as such at several other places explicitly or independently of Meluhha; The Meluhhans, the people of black mountain, brought exotic wares to holy Inana; elsewhere, the people of Marhasi (an ancient south Iranian country), brought animals which included monkeys, elephants and water buffaloes (--all native to India); and at that time, the storehouse of Agade was filled , among

other things, with silver, copper, tin, blocks of lapis lazuli and gold (--some or all of which may have been of Harappan origin) (Waekawa et al 2011:259-60)

E&N implores, 'May the land of Meluhha / load precious desirable sard, / mêsu wood of the plains, / the best abba wood up into large ships!' (Possehl 1996:143). In *EWO*, Enki decrees, 'Let the lands of Meluhha, Magan and Dilmun look upon me, upon Enki. Let the Dilmun boats be loaded with timber. Let the Magan boats be loaded with treasure. Let the *Magilum* boats of Meluhha transport gold and silver and bring them to Nibru for Enlil, the king of all lands' (Waekawa et al. 2011:261-62). Further, the texts talks of Meluhha as a land of precious metals, timber and exotic animals, and Enki professes, 'Black mountain, may your trees be great trees, may your forests be forests of highland mêsu trees! Chairs made from them will grace royal palaces! May your reeds be great reeds..........! Heroes shall ...... them on the battlefield as weapons! May your bulls be great bulls, may they be bulls of mountains!.................May your birds all be peacocks! May their cries grace royal palaces! May all your silver be gold! May all your copper be tin-bronze!' (Waekawa et al. 2011:262)

Enlil and Ninlil does not contain obvious reference to Meluhha, but provides some inferential information as some animals such as wild cat, tiger, water buffaloes and monkeyof distant foreign (eastern) lands, obviously Meluhha, were included in the bridal gift presented by Enlil to Sud, (Waekawa et al. 2011:264-65).

Some minor tablets and lexical texts also contain references to Meluhha: an incantation speaks of carnelian and lapis lazuli of the land of Meluhha; a tablet alludes to the cat of Meluhha and the elephant of steppe; a Lipšur litany designates Meluhha as the home of carnelian while Magan that of copper (Possehl 1996:143).

Possehl (1996:144) has also cited twenty-two references to Meluhha from later lexical and other writings of the Old Babylonian times: among them are diverse allusions to the country or the land of Meluhha, or to wooden furniture pieces such

as a table, or a chair, or a ship, or else other miscellaneous things of Meluhhan wood.

10.4.7 Summary of textual evidences

In sum, copious are the references to Meluhha as a country, as a land, as a land of black mountain, as a land of precious metals and minreals, of species of wood, of exotic animals and ivory and pearls, as land having its ships of transport which come up as far north as Agade - a city on the river in Mesopotamia; There are things in the style of Meluhha; there was an enclave of Meluhha, or even it has its army which is said to have joined that of the Iranian land Anshan to fight against the Mesopotamian forces.Waekawa et al. (2011:266) have presented in a table the different minerals mentioned in the literary sources, including the Gudea inscriptions, and shown the sources of origin in each case. According to that copper, tin, bronze, gold, silver, lapis lazuli and carnelian were coming from Meluhha. All the sources, by and large, attribute carnelian to Meluhha. In one instance, even diorite rock was sourced to Meluhha and Magan--it may be perhaps due to the fact a Meluhhan ship loaded it at a Magan port for its onward transportation to Mesopotamia. As shown above, there were many other products which were being exported to Mesopotamia by the seafaring merchants of Meluhha. All the items of export strongly fortify the argument that Harappannia was Meluhha that lay towards the east, beyond the "Lower Sea" (the Gulf) and was most plausibly approached through the "Sea of Magan" which should be the Gulf of Oman, a part of the Arabian Sea.

10.5 Artifactual evidence

The connection of the Harappan civilization with Mesopotamia is convincingly attested in the archaeological records which entirely come from the latter, whereas the Indus sites are strangely very poor in so far as objects of Mesopotamian origins are concerned. The textual details or corroboration, once again from Mesopotamian, is quite complementary as well as supplementary on the premise that Meluhha was Harappania. Those attestations allude to both perishable and imperishable products, or inanimate things and animate beings, those may have changed hands in trade. As may be gathered from the account, as already given before, about the goods

which were imported from Meluhha to Mesopotamia, included precious metals, semi-precious (then precious!) stones, wood, reed , ivory, pearls, animals and birds. Possehl (2002:220) has tabulated some of these by citing the number of attestations in each case about what occur in the cuneiform texts. Many of them are present in the archaeological repertoire either as actual objects, as raw materials, or as represented in art. The objects of Harappan origins in Mesopotamia, Elam or further northwards or eastwards include seals, sealings, etched carnelian beads, long cylinder beads of carnelian, art forms, representation of Indian animals, such as humped brāhamaṉī bulls, elephants, water buffaloes, rhinoceros and a few others either on seals or on stone vessels.

10.5.1 Seals

The Harappan stamp seals, square in form, with a typical pierced boss at the back, are the best identity markers, and were the first to be recognized as such as far back as 1924. The seals, whether square as in Harappania, cylinder in Mesopotamia or round in the Gulf, were powerful tokens of economic administration, besides being specimens of art and vehicles for depicting contemporary society and iconography. Significantly, Possehl (2002:221) has listed eighteen 'Indus, or Indus-like seals from the Near East', of which three each are from Ur and Kish, two each from Tell Asmar and Susa, and one each from Tepe Gawra, Tell Suleimeh, Tello, Lagash, Hamma and Nippur, including one sealing of unknown provenance, but believed to have come from Tell Umma. One of the eighteen is so-called seal from east Iranian Shahdad.

A square stamp seal from Ur, ascribed to the pre-Akkadian time (c. 2080 BCE), obviously late Early Dynastic III B, (Aruz, 2003:410,412, cat. no. 3016; Possehl 2002: 221,222, fig. 12.9) is immensely important as it combines in it a Harappan motif and a cuneiform inscription; the motif is a humpless bull with lowered head (over a food trough that is not often visible on round seals although always present on square seals in Harappania). Delineation of the bull and the

crafting of a sub-classical pierced boss at the back attribute it to be a handiwork of a Harappan artist who may have done it for a Indus merchant settled at Ur.

Another seal from Ur, ascribable to pre-Akkadian or Akkadian time (Possehl (late 3rd millennium BCE) 2002:221,223, fig.12.10) is a round one, bearing again a humpless bull with the lowered head and with an Indus legend in the upper margin, and having a typical round boss with a perforation. It too seems to have been made by a Harappan artist and carried there from the Indus home by a merchant.

A seal, datable to the late early Dynastic or early Akkadian from Tepe Gawra (Possehl 2002: 221, 223, fig. 12.11), is a square one bearing concentric squares as the motif, and with an awkwardly tall pierced knob; it may not be considered to be of Harappan, therefore, be dismissed form reckoning. However such seals with tall knob are present in the post Harappan Jhukar period in the lower Sindh.

A seal from Kish, attributable probably to a pre-Akkadian or Akkadian context, late 3rd millennium BCE, (Possehl 2002:221,224, fig. 12.16), has a swastika symbol that was quite popular with the Harappans for depicting it on seals and tablets. The other swastika seal from Shahdad, related to cemetery A, and dated to 2500-2000 BCE (Possehl 2002:221,226, fig. 12.23), seems to be a little doubtful for its Harappan affiliation as well as for its being a seal at all; it may gain some importance if the site does yield some Harappan material.

Significantly, an Akkadian house at Tell Asmar of the 3rd millennium BCE has yielded two important seals, one of which is a cylindrical one depicting elephant, rhinoceros, and gharial or fish-eating crocodile-'animals that are peculiar to India and are not found in Mesopoatamia' (Mackay 1938:7; Possehl 2002:221,223-224, fig.12.13). The animals both of which were masterly engraved, showing well their muscularity; while the other is a square one possibly exhibiting a temple plan on the obverse, and a pierced rectangular knob on the reverse. The motif does not appear to be Harappan. It was possibly conceived in Mesopotamia itself. However, the shape and the boss are Harappan in nature.

Kish has yielded a classical Harappan seal, said to be from an Akkadian context (Possehl 2002:221,224, fig.12.14), shows a unicorn, with a manger below its head and a balancedly cut Indus legend above it; it was surely made in India and carried to Kish by a merchant or a transporter. Another unicorn seal from Kish itself, probably from an Akkadian context (Possehl 2002:221,224, fig.12.15), displays perfectly the Indus standard in its form and execution with its well cut and balanced inscription containing about seven signs.

Tell Suleimeh has shown up a cylinder seal of the 3rd millennium BCE (Possehl 2002:221,225, fig. 12.17) that exhibits a unicorn with a pecking bird on its back, followed by a humpless bull with a fish (symbol) above it; the animals are walking to the left--a position normally unusual with the Harappan seal-cutters in the majority of the cases the animals, if to be considered in positive form, should look to the right. However, the craftsmanship seems to be by a Harappan artist who possibly cut it in Mesopotamia; showing two animals together is also not an usual Harappan style if it is not in a mythological context which is not the case in the present example.

The square seal from Tello, again dated to the 3rd millennium BCE (Possehl 2002:221,225, fig. No. 12.18), bears a tiger with a 5-sign inscription; it is a classical Harappan example both in its execution and form.

There are two seals from Susa, both attributed to Akkadian or post-Akkadian (Aruz, 2003:410,411, cat.no.301d; Possehl 2002:221,226, fig. 12.21). The first of them is a round seal with a humpless bull with lowered head and with a circularly displayed inscription, perhaps having six or seven Indus signs;). It is a typically Harappan in its craftsmanship. The second one (Aruz, 2003:410,411, cat.no 301c; Possehl 2002:221, fig.12.22) is the impression from a cylinder seal betraying two humpless bulls, standing one behind the other; some details on the lower margin are missing though, one of the bulls has a food-bowl under its head, while in case of the other damage has obliterated further details, but, however, the well cut inscription

with the Indus characters is duly present. The seal was surely engraved by a master craftsman.

Two seals--one from Hamma and the other from Ur--are put in general in the first three centuries of the 2nd millennium BCE. In case of the Hamma example (Possehl 2002:221,225, fig.12.19), it appears to be a fragment of a square seal, showing the forepart of a bull with hump portion and the rest of the body missing however; the bull has a wide circular eye, and down below are the traces of a manger possibly, hence was a zebu. In execution, it appears to be a local manufacture, perhaps. The Ur example (Aruz, 2003:410-11, cat.no.301a; Possehl 2002:221,fig.12.8) shows a zebu with a wide circular eye, followed by a large-sized scorpion; under the head of the bull is a multi-pronged object, in front of the bull is a date palm tree, besides there is a snake and also a star-headed human form lying horizontally in the upper right zone. It too may be of a local manufacture. Chronologically, both these seals may belong to the closing century of the 3rd or the first century of the 2nd millennium BCE, because after that time the direct Harappan trade had, perhaps, ceased to exist in Mesopotamia, and secondly such seals with motif were being made in India no longer.

The Nippur specimen came from the debris of the Kassite period, 14th century BCE, (Possehl 2002:221, 12.20). It is a classical Harappan seal showing a majestic zebu with an Indus inscription above. The seal should have come from an earlier deposit and got mixed up in the later debris, otherwise it is a standard seal of Harappan workmanship of the 3rd millennium BCE.

The Umma piece is a highly significant owing its being the only sealing stamped from a standard Harappan seal of the classical phase, with impressions of textile on the reverse (Possehl 2002:221-22, fig.12.7). Its chronological status remains unknown however, it shows impression of a unicorn, with a well cut inscription, all of which point to its being a standard type. The object that is placed below, under the head of the animal, anyway, does not appear to be the typical

manger if the copy is correct. It is, however, certain that the seal was stamped on a bale that was wrapped in cloth.

10.5.2 Etched carnelian beads

The civilizational contacts between the Indus valley and Mesopotamia predates any epigraphic or sigillographic testimony, and that is evident by the presence of the etched carnelian beads in the personal jewellery from the Great Death Graves of Ur going as far back as the Early Dynastic IIIA (C.2550-2400 BCE) (Collins 2003:130-31, cat.no. 79 a , b).

The etched carnelian beads (fig.10.2) were highly specialized craft products of the Harappans and, therefore, their presence is testified almost at every Harappan site, and as such have become strong marker of the classical phase of the civilization. Evidences show that these as luxury items were much in demand in the countries, particularly advanced ones, with which the Harappans established their trade contacts. The decorative white patterns on the surface of the carnelian beads of short and medium sizes were created by way of etching with the aid of chemical solution it must have been practiced at many centres of production. The etched carnelian beads are reported, besides Ur, from Nippur, Kish, Eshunna in Mesopotamia, Susa, Tepe Hissar, Tepe Yahya in Iran, in Bahrain, and Tell Abrag, Umm an-Nar in the Gulf (Aruz 2003:242, fig.74 (map). Furthermore, these are found at Hili North grave A in U.A.E (Cleuziou et al.2007:126, fig.128) as well as Aigina in Aegean (Collins 2003:261 cat.no. 166 a, b)

10.5.3 Other Carnelian beads, including long cylindricals

Harappans produced a huge number of carnelian and other beads. Among them long cylinder beads--cylindrical, barrel-shaped and biconical--were equally specialized products which were indeed Indus innovations. It may be relevant to state that the best quality of carnelian is said to come from Gujarat in India, and that is why Lothal and Dholavira (both in Gujarat) emerged as vibrant bead-making centres, and the other being Chanhu-daro in Sindh. In fact, bead making seems as

if practiced as a cottage industry. The beauty of long beads is best exemplified in the famous girdles from Mohenjo-daro (fig. 10.3) and Allahdino.

The best examples of these long and modestly long beads have been found in the “Treasure of Ur” from a palace court of Mari (Syria) (Choldis 2003:143-45, cat.no.85 a , b) (fig. 10.4). If the mineralogical study on the material and technological work on beads are carried on the specimens from western sites, the way it is done in India, the results would be revealing to figure out as to what an amount of ordinary beads were also being exported along with the specialized ones. It may not be an exaggeration if it is believed that the carnelian beads were exported in bulk to the west.

10.5.4 Other aspects of the importance of the Mari hoard

Among a miscellany of objects in the Mari treasure, those of significance in the Harappan context would be the finds of a vase of Reserved Slip Ware (RSW) pottery, an ivory statuette and a great amount of lapis lazuli, either in jewellery or in art.

V.N. Prabhakar of the Archaeological survey of India (personal communication), during his visit to Syria, noticed the said (RSW) vase in the hoard (fig. 10.5). It has an astonishingly close similarity to the ware as well as the shape that was another specialty of the Gujarat Harappans all through the 3rd millennium BCE, whereas its presence outside the state is nil, but for a few sherds from the lower levels of Mohenjo-daro. Its presence in distant Mari seems to be of immense importance and curiosity.

So far as the ivory statuette (Choldis 2003: cat.no 83) is concerned, it is Mesopotamian in style and norm, but the very use of ivory is significant by itself as the source of the raw material should have been from India, not Egypt, in view of the mercantile intimacy of the former with Mesopotamian world and near absence of the Egyptian objects in the land under discussion.

In the treasure, the use of lapis lazuli in the form of beads and its use in art (eagle pendent) are striking. The only known ancient source of the mineral is Badakhshan in north Afghanistan. The Harappans had established a township there, far away from their homeland, at Shortughai, which is perched on a terrace of the River Kokcha, a tributary of the River Oxus (Francfort 1989). We believe, for the sake of having full and effective control over the lapis mines in the headwaters of the Kokcha, the Harappans had a town there. Besides, tin sources are also in that region that includes Uzbekistan too. It is very likely that the Harappan traders were directing the lapis lazuli from there to Mesopotamia and elsewhere through both overland and overseas routes. Even more than two millennia later, say the first/second century CE, the lapis lazuli was being brought to the Indus port of Barbaricum from where it was exported to the Roman ports (Schoff 1974:37-38, 170-71), thus probably pointing to a very old tradition.

A highly significant component of the hoard is a lapis lazuli bead, bearing a cuneiform inscription in the Sumerian language, introducing 'Mesanepada, king of Ur, / the son of Meskalamdug, king of Kish' (Cholidis 2003:143, cat.no.84) possibly as a donor. Whatever controversy that surrounds it, the strongest possibility is that the bead, and also many items of the treasure, may have originated from Ur, which had otherwise shown strong trade links with Harappania, albeit this particular bead is non-Harappan owing to its being a faceted one--a feature that is un-Harappan in nature. The Mari treasure is, however, pre-Sargonic (c.2550-2400 BCE), to which time the Royal Graves of Ur, yielding many etched carnelian beads, of India belonged.

10.6 Representation of Indian animals in the Mesopotamian art

10.6.1 Water buffalo

We have given references in the literary texts to water buffalo, which is native to India. Its visual representation may be seen on the cylinder seal of Ibni-sharrum, a scribe of the last Akkadian king Shar-kali-sharri (c.2183-2159 BCE). It shows two masterly executed buffaloes shown on either side of a hero. Each buffalo is shown

drinking water from a stream springing from a vase held by the hero. The first appearance of the exotic water buffaloes may been seen during Sargon's reign, evidencing 'the relations that existed between the Akkadian empire and the region of Meluhha in the Indus valley' (Demange 2003:208-09, cat. no. 135). The animal had obviously entered in the Mesopotamian mythology.

10.6.2 Zebu (brāhamaṉī bull)

Two addorsed standing zebus, carved dexterously on chlorite vessel, datable to the mid - 3rd millennium BCE, often said to have come from Khafajah, are shown with a hero who holds streams of water on both hands and each stream flows past the mouth of each bull as if being offered to it. In addition, a humped bull is knocked down by a lion and preyed upon by an eagle, too, is shown on the right side of the vessel (Benoit 2003: 330-32, cat 227 & fig. 85). Here too the Indian animal has gone into the mythological lore. Furthermore, the occurrence of a zebu with a scorpion, along with other details, on a seal from Ur has already been discussed under seals.

10.6.3 Elephant and rhinoceros

These animals, which are native to India, are seen together on a seal from Tell Asmar and have already been referred to earlier under seals.

10.7 Other Artifactual Evidence

10.7.1 Spiral ornaments

Double-spiral or quadruple – spiral pendants or beads have been reported from several places such as Ur, Ashur, Tepe Nush-i-jan, Tell Brak, Eskiyapar, Alaća Hỏyűk, Troy, Poliochni, Gonur Depe and Aali, located in different culturo - geographical zones (Aruz 2003: fig. 73). Such ornaments first appeared at Ur where both types of pendants in gold were found in the Early Dynastic IIIA (c. 2550-2400 BCE) context (Collins 2003:129-30, cat. nos. 77-78). Nagar (modern Tell Brak) has also shown up such beads in silver, assignable to the Akkadian (c.2300-2159 BCE). Quadruple – spiral gold bead is found at Troy of Early Bronze Age (c.2500-2300 BCE), Anatolia, where Ikiztepe mound 1 of the same age has provided quadruple – spiral plaques of copper alloy. The Tepe Hissar (Iran) example of double - spiral

pendant is in the time-bracket of c.2500-2000 BCE. These finds do not seem uncommon in the west.

One spiral ornaments have been recovered from Dholavira (fig. 10.6A) and four from Pithad (Saurastra, Gujarat two of which are illustrated here (fig. 10.6B and C). Double spiral-headed pins have been reported Harappan sites

10.7.2 Flat beads with tubular hole

Flat beads of gold or silver with an axially tubular hole have a wide distribution from Harappania to the Aegean Sea (Aruz 2003: fig. 72). Such beads in India are not confined to Mohenjo-daro, Allahdino but are present at most of the large or important Indus sites (fig. 10.7) – strong interconnection between the east and west of the later half of 3rd millennium BCE is thus evident.

10.7.3 Recumbent statuettes

Small statuettes of bulls and rams in stone or bronze in the Harappan art have parallels in Mesopotamia as well. Illustrating the recumbent bull from Lothal, Possehl has remarked ‘The look and scale of this piece is very much like those from Ur and other Mesopotamia sites’ (Possehl 2002:228, fig.12.29)

10.7.4 Trefoil design

The famous so-called ‘priest’ or ‘priest –king’ from Mohenjo-daro bears a shawl/cloak decorated with trefoil designs, which are rather depressed as if to receive some inlays or filling of coloured paste (fig. 10.8). There are other art pieces decorated with similar trefoil design (e.g. Ardeleanu-Jansen 1989: figs.1-4 and 18). The same decoration may be seen on a steatite vase fragment from Ur, or on alabaster mosaic fragments from Dashly 3 (Ardeleanu-Jansen 1989: fig.19 &20 respectively), or on a recumbent human-headed bull from Mesopotamia of Ur III period (André-Salvini 2003:440-41, cat.no 313). It is a case of sharing of sacred motif between two contemporary civilizations.

10.7.5 "Contest scene"

In the Mesopotamian legend of Gilgamesh, the hero is shown fighting with two lions in the Mesopotamian art. The idea seems to have travelled to India with a change, as a hero here contests with two tigers on a Harappan seal and several tablets (fig. 10.9).

10.7.6 Toilet implements

Possehl (2002:227, fig.12.28) has also drawn attention to a toilet equipment, consisting of an ears coop, piercer, and tweezers from late levels at Harappa, and compared it with similar eleven (or twelve) sets reported from Ur and Kish. It is not commonplace in India, hence be an import from Mesopotamia.

Many more such similarities can be surmised or thought of showing the flow of ideas or exchange of items between Harappania and Mesopotamia. The account may be closed by referring to two cylindrical seals, one from Kalibangan and the other from Rakhigarhi. We know these are not Harappan in form though, the motifs on them are truly Harappan, hence pointing to the fact that these are inspirational rather than normal in the huge corpus of the Indus seals.

10.8 Architectural evidence

As stated earlier, use have used the term 'architectural' in a widely liberal sense so as to include a miscellany of things: the Lothal dock, probable port towns and also the representation of boats in the Indus art.

10.8.1 The Lothal dock

Lothal has become famous for its dock along with its appurtenant wharf, nearby warehouse and a building that may have served as a hostel for the visiting merchants (fig.10).

The dock (Rao 1979:123-33, fig.19) is a brick-lined structure enclosing a traperiod basin on the eastern margin of the town (fig. 10.11). Its western, eastern, southern and northern embankments measured in meters 218.24, 214.88, 35.66 and 37.50, respectively, while its side walls, extant to a maximum height of 3.35 m,

should have risen originally to 4.15 m so as to be at par with the top of the mud-brick wharf. It was furnished with a broad inlet-channel allowing boats to come in, and also with a sluice gate with a locking arrangement in order to control the level of water in the basin so that the boats, coming from or going to the Gulf of Khambat, could be easily berthed for loading and unloading of the merchandise on the wharf.

The presence of anchor stones as well as marine micro-fauna in the sediments of the basin, its straight high walls without any stairs or ramp, provision of broad inlet-channel and its connection to a sanitary drain vouch for its being a dock, not a freshwater tank as counterargued by some scholars. Besides, high salinity in the soil forbids its being a freshwater tank there. Topographically, a dry estuarine channel, emanating from the River Bhogava, suggests that there might have been a navigable creek or estuary when the protohistoric sea of the 3rd millennium BCE should have been three to six meters higher than the present sea-level. Today, the surrounding ground-level is only 12.5 m higher than the mean sea level; it may also be kept in view that the entire Saurashtra is vulnerable to neotechnic activity which may have uplifted the land as happened in Saurastra, Kachchh and Makran.

10.8.2 The Harappan boats

Lothal is the only site, which has yielded miniature terracotta models of three types of boats: (1) sailing boat, (2) flat-bottomed barge-like boat, and (3) a heavy boat, with a broad stern, and pointed prow. Another type is said to be a narrow a catamaran as well (Rao 1979:132). Mackay has described and illustrated a" ship" with a sharply upturned prow and stern, and with a square cabin in the centre (1938:340-41,30, pl.lxxxix A)(fig.B). He has also referred to and illustrated a sail boat or ship scratched on a potsherd (pl. lxix,4 Mohenjo-daro has yielded a triple-faced tablet in bas-relief (M-1429), one face of which carries depiction of a long boat with a central cabin, and with two birds, the latter of which are interpreted as diśā-kāka, path--or land-finding crows or birds; the second face bears a fish-eating crocodile and the third one an eight-sign inscription (fig.A).

Keeping in view the maritime nature of the Harappans, their art is quite poor in providing representation of boat and ship.

The “Persian Gulf” seal (fig. 10.13) (Rao 1985:312-313, fig.38 A, pl. CLXI,B-C), two Omani-type seals (fig. 10.14) (Rao 1985:318-19, pl. CLXI,D; and-317, pl. CLIX, C.1), and bun-shaped ingot of copper (Rao 1985:520-21, fig.118.4, pl.CCXLVII,A) (fig. 10.15)--all from Lothal further accentuate the external contacts of the Lothal Harappans with the Gulf and the eastern Arabia towards the end of the 3rd or the early century of the 2nd millennium BCE.

10.8.3 Other probable ports

Dholavira (Gujarat), an extensive Harappan metropolis of great industrial and commercial importance, which is located in the centre of the Great Rann, was most possibly an important port. (Bisht 1991:71-82; 1997:107-120; 1999:14-37) The Great Rann was most plausibly an arm of the Arabian Sea in the 3rd millennium BCE when the sea-level was 3 to 6 m higher, the sediments in the Rann were far lesser in depth and when general upliftment of the landscape of Kachchh due to still active neotectonic activates had not taken place. The presence of the fragments of copper ingots and the find of two steatite/chlorite vessels (fig. 10.16) further emphasize the external contacts so do the round seals from seven Indian, Bahrain, Mesopotamian and Elamite contexts, a few are illustrated here (fig. 10.17).

Balakot, in the Sonniani Bay of the Arabian Sea, was another (fortified?) Indus settlement (Dales 1979:45-53) which may have served as yet another port where goods were exchanged and food provisions, particularly drinking water, were freshly procured for the journey.

Sotka-Koh and Sutkagen-dor was two fortified Indus settlements in Makran. (Dales et al. 1992) Today, both lie away from the coast. But in the 3rd millennium BCE both were almost on the coast as borne out by recent geomorphological studies which demonstrate that the littoral Makran has uplifted by 9 to 9.5 m (Besenval 2011:59, fig.177 b, cf. fig.177 a).

10.9 Magan

10.9.1 Textual references

The earliest mention of Magan in Sargon's proclamation is proverbial, however the Akkadian state records also speak of the import of copper, chalcedony and bronze products from Magan under the supervision of a state official called 'gaesh', who was a very powerful state functionary for overseas trade, and sometimes also officiated as collector of revenues (Waekawa et al. 2011:249). The third Akkadian king Manishtushu (c.2235-2221 BCE) led his victorious expedition against the combined forces of thirty--two countries of the 'Lower Sea,' obviously to establish his supremacy over the Gulf. One of the inscriptions of the fourth Akkadian king Naram-Sin (c.2220-2184 BCE) tell of the 'booty of Magan' while in another one the 'sea' and Magan are cited side by side. Gudea of Lagash (c.2090 BCE) got several of his own statues made on diorite that was brought from the 'land of Magan' to Sumer. In another of Gudea's inscription there is mention of the 'mountains of Magan' which, some scholars seek to locate in the Iranian highland, not in Oman peninsula. That is why some do hold that Magan may stand for the Iranian coast or else a wider area that included both the Iranian coastland and the Oman peninsula.

Later, both Gudea of Lagsh and Ur-Namma of Ur, who were near contemporaries around 2100 BCE, re-established the maritime trade with Magan (Waekawa et al. 2011: 252-54) Both the kings individullay boast of how they selected Magan as a trade partner. During the same Ur III period (c.2100-1989 BCE), according to Waekawa and Mori (2011:253), Magan became a chief stopping point in the Gulf region; goods (such as wood, minerals or finished products, ivory, etc.) from India and other lands passed through the Magan ports to those of Mesopotamia. Furthermore, barley, textile products and silver were bartered with minerals, wood and other exotic products at the port of Magan (Waekawa et al.2011:255). It is further said that a letter from a local governor (Puzur-Shulgi) to the last Ur III king (Ibbi-Sin 2013-1989 BCE), although a later copy, makes reference to the 'Sea of Magan', often taken to be the Gulf, (But to me the 'Lower Sea' meant the Gulf, while the 'Sea of Magan' may very well stood for the Gulf of Oman that

stretches eastward from the Strait of Hormuz to Makran and beyond, thus connected the coastal Magan to Meluhha through theArabian sea that lies athwart between the south-eastern Arabia and Makran. Further, one among various Lagash texts, states about giving ration, in the form of bread, beer and oil, to those (traders) of Magan who were either coming to or going from Lagash. This is, however, the only one such citation that mentions Magan along with the other Iranian countries of Susa, Anshan and Shimashki, while these countries occur together in other texts in the same context of issuing ration, but without including Magan. However, the solitary reference to Magan has its own importance.

In the year 2026 BCE, during the region of the last Ur III king Ibbi-Sin (2013-1989 BCE), a cargo consisting of gi-wood, Halpha-grass, palm fibres from the “seal-house, bundles of clothes, sesame oil and animal skins set sail at a Sumerian harbour; The cargo belonged to the merchants Ur-Shulgi, Lugalgaba and Ur-Shurpae, who invested and delivered the goods to captain Luenlil in the hope of good profit from the Magan copper in return. The ship set off and called at the harbour of Dilmun/Bahrain to take on fresh water, and finally arrived at a harbour in the Oman peninsula, perhaps Umman-Nar island, lying offshore (present-day) Abu Dhabi (Weisgerber 2007:195). Weisgerber dramatically visualizes that bands of porters and caravans of donkeys brought copper in bun-shaped ingots not heavier than 1-2 kg from the smelting centres of the Omani mountains to the island harbour. He further adds, that they loaded copper cargoes of up to 18 tons, accounting for 10,000 to 18,000 ingots, (Weisgerber 2007:196).

During the second millennium BCE, in the post- Ur III period, i.e. Old Babylonian, Magan seems to have lost its importance in maritime trade and Dilmun had emerged as the partner instead.

Ratnagar has compiled from the texts fifteen items to have come from Magan (1981:39), but many of them, like carnelian and other stones, ivory, gold dust and some kinds of wood, may have originated in India and routed through the Magan ports, while copper, Magan reed and Magan onion could be of Magan origin. So far

as diorite or olivine gabbrois concerned its Provenance in Oman still remains to be proven. Some other things or products such as ‘U’ and ‘Sumin’ of Magan as included by Waekawa et al (2011:266), remain difficult of identification.

In the old Babylonian literary composition, *Enlil and Ninlil*, three categories of animals, viz. wild animals; large tame animals; small tamed animals, were brought from ‘very distant from humanity’; ‘Most of these animals are those which originate in the east, such as the tiger, wild cat, water buffaloes, and monkey’. No doubt these were imported, along with many others, like peacock and crow (?) from Harappania, some of them, including zebu, scorpion, elephant, we shall see later, appear in the art of the Akkadian period.

10.9.2 Archeological evidence

The Danish excavations in the islands of Failaka, Bahrain and Umm an-Nar from 1954 to 1960 opened up a new world for archaeological investigation. Since several archaeological expeditions have been led by several international teams a good deal of data has been amassed, yet the emergent picture, by and large, remains nebulous and *disjecta membra*. This as well holds good in case of the Oman peninsula where the archaeological scenario is patchy and sketchy, and bereft of the ostentation of either of the Indus or Mesopotamian civilizations. It lags far behind Iran either. Much of the information is gathered from graves, and some from low-key settlements, often associated with impressive towers made of stone or mud-brick. These settlements located either in islands, or along coastlines, or nestled in oases lying along the central mountain range that runs from the north-west to south-west across the peninsula.

The Bronze Age Oman has been broadly divided into the Hafit culture (c.3000-2500 BCE), the Umm an-Nar culture (c.2500-2000 BCE) and the Wadi Suq culture (c.2000-1700 BCE). At present, ‘there is only one sequence running through the entire time-span that is Hili 8 in northern part of Buraimi/Ain oases agglomeration’ where nine C^{14} dates inscribe its occupation between c.3000 and

1800 BCE, while the rest of the sites yield single period complexes (Cleuziou et al. 1989:19)

The Hili period I, having three structural phases, is said to be contemporary to Jamdat Nasr and Early Dynastic I, with a time that may have been slightly earlier than 3000 BCE and it lasted for three or four centuries.

The next cultural phase is Hili II a to g having four chronological sub-periods ranging from c 2650 to c 2000 BCE, which is Umm an-Nar period that covered the time-span from the part of Early Dynastic II to Ur III. This was the time which also included the time of vibrant interaction with the Harappan civilization in the eastern Arabia during c.2500-2000 BCE.

The final period III, Wadi Sug culture, may have ranged from c.2000 to 1700 BCE. Of this particular period, Hili is the only excavated settlement, while the rest are only graves lying at Qattarah in Buraimi/Ain oasis, Shimal, near Ra´s al-Khaimah, Wadi Suq, Wadi Sunaysl, Khudra, Maysar (Moyassar) and Masira island.

The above account is derived from what has been given by Ceuziou and Tosi (1989:19-21 & table 2). During this long time-span there were different phases of Mesopotamian connection, south-east Iranian expansion and Harappan intervention. Period I at Hili 8 comprises both the Mesopotamian and Mesopotamian--like pottery (Cleuziou et al. 1989; fig. 2) as well as the south-eastern Iranian painted (Cleuziou et al.1989: fig.6) ceramics. The authors further add that Hili 8 has yielded the sherds of about 30 vases, which are ‘predominantly, but not exclusively, of Mesopotamian type; and also that similar class of pottery is also ‘a recurrent element among grave-goods of all cairns of the “Jebel Hafit horizon”, not only in the Buraini/Ain area but also deeply in the Oman peninsula along the Interior Oisis Belt’ (Cleuziou et al.1989:27). In addition, square spacer of frit or heated steatite, found in the Jebel Hafit graves, are found widely distributed over a large area from Jamdat Nasr to Early Dynastic II times in the context of Susa C, Hissar II B, Khafajeh and Tell Agrab (Cleuziou et al.1989:30, fig.1). They further inform that, on the very first appearance

of the Mesopotamian pottery, During Caspers did opine about 'a possible Jemdet Nasr 'colony' in the neighbourhood of Buraimi' Anyway, this foreign contact was surely prompted by the Oman copper that was so acutely desired by the riverine civilization.

The presence of the south-eastern Iranian pottery in Oman is also striking. The Umm an-Nar graves have yielded such pottery that is exemplified in the black on red painted vessels of fine red ware (fig. 10.18), painted grey ware and incised grey ware ceramics (fig. 10.19) of the south-eastern Iran. Similarly, painted and incised grey ware pottery is reported from tomb A at Hili North: the incised vessel was chemically analyzed and found to be a copy of Iranian pottery made locally, while the three specimens originated from south-eastern Iran. In this regard, we are tempted to cite the circumstances of similar findings from Makran.

In Makran, we have stated earlier that the cultures right from period I were oriented towards the south-eastern Iran, instead of India. We are now dwelling on periods III b and III c, designated as Dasht culture 1 (2800-2600 BCE) and Dasht culture 2 (2600-2500 BCE), respectively. Both these two, too, look west in affiliation. It should be most relevant to state at the outset that the period III c was followed by the full-blown Harappa culture which arrived there from the east, obviously (Besenval 2011:51-52).

The period III b material was not found in a stratified context though it is, however, represented by 'important agricultural settlements, large areas of potters' activities, and cemeteries', and also that this period was preceded and followed by firmly established stratigraphical contexts. In the present context, its importance lies in the presence of incised grey ware painted ("Emir") Grey ware, orange-red or grey ware with painted and ridged decoration, because much of this pottery is found duly present in the SE Iran and Oman, and secondly, its chronological status is much more compatible with what we are dealing with in Oman. Significantly, these ceramics were absent in the preceding Shahi Tump culture. More significantly, these wares, barring the Emir Grey ware, continue in the following period III c, the relics of

which were found immediately underlying the considerable deposit of the Indus culture which seems to have lived its full life there. Culturally, period III b is comparable to Bampur I-IV and Shahr-i-Sokhta II, while the following III c is paralleled with Bampur V-VI and Shahr-i-Sokhta IV--- these are the cultures with which the contemporary Oman ceramics seek for interrelationship.

Incidentally, attention may be drawn to a majestic figure of a humped (Brāhmaņī) bull drawn on a red ware jar of period III b (Besenval 2011: fig 137), which should have been the source of inspiration for the artists who engraved this bull on a large number of the “Intercultural style” chlorite/steatite vessels which are, so widely distributed in the western world of the early Bronze Age, and a specimen of it has been reported from, Umman-Nar.

Reverting to Oman peninsula the suggested chronology as folloes may get wider acceptance, and the whole gamut of evidences is reviewed afresh:

Period I : 3050-3000 / 3000-2900 BCE

Period II : 3000-2900 / 2900-2800 BCE

Period III : 2900-2600 / 2800-2500 BCE

Period IV : 2500-2100 BCE

V

Period VI : 2100-1900 BCE

By the middle of the 3rd millennium BCE, there came about a turning point. It is may be a hypothetical proposition whether Oman was initially a ‘dependency’ or ‘colony’ of Mesopotamia and then it came under the influence of south-east Iran. In the both cases the Oman copper was the most covetous item. There may have been a rivalry between Mesopotamia and Iran that at point of time, and in that Iran perhaps succeeded owing to its geographical proximity. But later, the Harappans

seem to have jumped into the arena with aplomb and remained active with elan for five centuries or more.

Normally, in an archaeological situation, when two cultures interact with each other, there occurs exchange of select items, or sometimes of ideas, but pottery does not normally move into each other's zone beyond the buffer. If it does move it denotes a movement of people, which may be aggressive or friendly. When we view the situation in Oman, we find a situation in which the Indus pottery rather strongly moves in along, and the forms are not limited strongly to what were absolutely necessary for transportation of some specific things. In Oman it moves along with even some iconic forms too, but, strangely enough the strong tokens of economic administration such as seals and sealings, or of economic necessity like weights, excepting one from Shimal that of a later date, do not travel in. Even the luxury items such as special beads or ivory combs are minimally present. But the pottery, although selective, is more or less ubiquitous from Ràs al- Hadd, or Ràs al-Jinz, on the eastern coast to Umm an-Nar on the western end.

The next in importance from the Omani sites are the utilitarian copper tools consisting of celts, bar celts, chisels, points, pins, wire and fish-hooks (figs. 10.20), the like of which may easily be seen in the Harappan corpus. Most of them may be industrial tools which were used in mining, digging, cutting trees, breaking and dressing stones, carpentry, etc. Fish-hooks which too are in large number were the part of subsistence equipment. One thing that is remarkable is the rarity of the weapons of offence like arrow-heads, spear-head. The Harappan presence in Oman was by all means peaceful and commercial.

The assemblage of the Harappan pottery in Oman comprised large, black-shipped storage jars, dishes-on-stand, perforated jars, S-shaped jars, pots and vessels (fig. 10.21). Most significantly, much of the Harappan pottery was imported from the Indus valley while some of them were manufactured locally. A few of them were decorated with typically Harappan motifs executed in black over red background.

The black-shipped jar (fig. 10.22) is a most specialized form which is one among the classical shapes in the ceramic corpus of the Harappan culture. It has a globular body, a modestly wide mouth; it is normally made of dense paste, is baked hard and slipped almost all over with a resistant, water-proof black slip, both externally and internally. It has a wide distribution in Oman. It has been reported from the excavated sites of Ra´s al-Jinz, Hili8, Bat, Tell Abraq and Kalba-4 and from the explored sites of Ra´s al-Hadd, Wadi al-Fajj, Asima, Khor Bu Ali SWY-3 and from Ra´s Abu Daud to the North of Quriyat (Méry et al. 2005:235-33).

These black-slipped jars are the most frequent type of the Indus pottery that is present at the coastal sites in the interior, along the communication routes as well as in very isolated sites (Méry 2007:199). Méry rightly calls it 'a most common large transport vessel' which could have been used for carrying liquid and semi-liquid goods like pickles, ghee, wine, honey, medicine and drinking water, (but not indigo as held by Kenoyer because it which was marketed as dry solid cakes). Méry further adds that the shape of the jar is difficult to handle, but the same 'render stacking and shipment by river or sea relatively easy', by securing the containers with straw and mats. Instead of stacking these jar against the curvilinear hull of a ship, we propose that a solid wooden fixture with a series of adequately wide holes, firmly fitted in a ship, boat or cart, would have been ideal for letting in the tapering lower body of a for in each hole. The lower part could be highly padded with soft material like cloth against attrition. A pile of straw sand could be spread underneath for additional safety. Some kind of cushioning may also have been used to secure each jar against jerks. When found in household, the lower body of a jar is invariably set into the ground.

Chemical characterization carried out on the specimens from Oman, Harappa, Mohenjo-drao, Nausharo and Miri Qalat by Sophie Méry and M.J. Blackman have demonstrated that the imported pieces in Oman were manufactured in the lower Indus valley where Mohenjo-daro is located and none from any other

area, although they also indicate a possibility of other centres of production which are yet to be located (2004: 227-35).

Another important observation was made that the higher number of jar sherds at Ràs al-Hadd, which is a favourable anchorage, showed that the foreign shipment was brought there the contents were removed and redistributed to other places, and also that the jar too were refilled with other substances and sent to other places hence the presence of these jars at several places, including the remote ones.

Likewise, laboratory test has confirmed that while many other Indus pottery types came from the Mohenjo-daro region, some were copied in local wares as well. In that case several pots which are found in graves in Umm an-Nar were imported from the lower-Indus valley. This was the scale and nature of maritime transport between two areas.

Ra´s al-Jinz on the eastern coast of Arabia, 10 km to the south of Ràs al-Hadd, has yielded from two residential units rimless part of a painted S-shaped of the Indus pottery, an ivory comb and a copper seal, a number of pieces of the Mesopotamian bitumen for caulking fishing boats (Cleuziou et al. 2007: fig. 253). The copper seal which was much corroded was X-rayed and it was found that it bears the Indus unicorn with a manger and an inscription in the upper margin (Cleuziou et al. 2007: fig. 253) Ra´s al-Jinz has also offered two inscribed sherds exhibiting Indus signs. One was a surface find while the other was on a storage jar recovered from a domestic building (fig. 10.21C). The same site also yielded Oman-type stamp seals of steatite one bearing two human figures and a plant on the obverse and two dot-m-circle motifs flanking the central knob, and the other bearing a human figure possibly with an animal resembling a dog, or just a symbol (fig. 10.23). The latter has a ring-boss. The motifs are drawn deep and broad. The execution and style recalls one of the Lothal seals bearing an anthromorphic figure with some symbols which do not appear to fall in the Indus category (fig. 10.14A). The same site has also yielded a rectangular seal bearing some indistinct signs on the obverse and the reverse has two dot-in-circle symbols flanking the central knob.

This seal is certainly an Omani one (fig. 10.14B). Like the “Persian Gulf” seal, it was found at Lothal from the surface and may be dated to the close of the 3rd or beginning of the 2nd millennium BCE. These seals further indicate active contact with Oman. This is important that Oman has so far yielded only eighteen steatite seals, some of which are improvised one as those are cut out from the lids of steatite vessels which too are peculiar to Oman Ra´s al-Jinz has offered two other seals (fig. 10.23A) on which the excavators have observed some kind of writing which is different from the Indus style. All those seals together, with two from Lothal, appear to belong to one genre. To the same group belongs a three sided seal showing highly stylized animals, a scorpion, a guadruped, goats, a zebu and a wild goat (Cleuziou et al.2007:).

A Oman-type steatite vessel is also recovered from the late levels of Dholavira, datable to the turn of the 2nd millennium BCE. The Omani sites have yield a good collection copper tools which are mostly Harappan-like in form and technique (figs. 10.20 and 10.23). Ra´s al-jinz has also yielded an Indus ivory comb(fig. 10.25).

Grave 1 and the associated bone pits at Ràs al-Jinz have yielded more than 12,500 beads which included those of carnelian, faience, steatite, shell, four tiny golden beads and some fish vertabrae (Cleuziou et al. 2007: fig. 127) Abrag has also yielded one etched carnelian bead of Indus origin.

More importantly, Hili North grave A (c.2300-2200 BCE) has yielded four carnelian beads one is etched white and the other bead has been entirely rendered white and decorated with black patterns. All those four are of Indus workmanship (Cleuziou et al. 2007: fig 128)

A grave in Shimal has offered an Indus chert weight of standard denomination. It is dated to the close of the 3rd or beginning of the 2nd millennium BCE.

10.10 Dilmun

10.10.1 Prelude

The earliest mention of Dilmun occurs in the texts of the late Uruk period (c. 3200 BCE) in a manner that is suggestive of the trade relationship, and its confirmation probably comes from AS 27 settlement in al-Abquaiq area in Saudi Arabia, which has inter alia provided a C^{14} date that is calibrated to 3100-3010 BCE (Zarins1985:75). Zarins also adds that the references to Dilmun in connection with trade, particularly in metals, increase “dramatically” in the records of Uruk III that is equated to the Jamdat Nasr period (c.3000-2900 BCE) (1985:75). Quoting Piesinger (1983: 494-5), the author concurs that the brown-faced or red-faced ware of possible Ubaid date was followed in sequel by an occupation that is dated to late Uruk through Early Dynastic I periods (c.3300-2650 BCE). Further Zarins draws attention to seven forms of pottery, recovered in bulk from the Abquaiq grave, belonging to the Early Dynastic I (c.2900-2650 BCE), although some of the types, according to Potts, as quoted by Zarins, continued into the succeeding Early Dynastic II (c.2650-2550 BCE) and Early Dynastic III periods (c.2500-2250 BCE) as well (Zarins 89:78)

10.10.2 Textual references

By the middle of the third millennium BCE, Dilmun had emerged as an important emporium, a large trading region of which, in due course of time, the island of Bahrain became the central seat of authority and an entrepôt for foreign goods coming from all directions (Mesopotamian, Magan, Elam, Iranian highlands and distant Meluhha), with the admission that much or some of the merchandise was being shipped directly to the Mesopotamian ports, including the riverine ones. However, Dilmun oftentimes occurs in the Sumerian records bearing on business transactions: Ur-Nanshe, the founder of the first dynasty of Lagash (c.2450) drafted the “ship of Dilmun’’ to bring wood to his city; “Dilmun ship (-shaped) bronze vessels’’ were dedicated to the temples both by the royalty and aristocracy of the early Dynastic III Lagash; the coming of copper and other precious items of import out of the Dilmun trade,(Waekawa et al. 2011:246-47), though none of those commodities was naturally occurring in the Arabian shores of the Gulf, hence must

have been brought there from somewhere else, such as Magan and distant Meluhha. Besides there are literary compositions speaking of traders bringing exotic objects such as minerals, wood and perfume from foreign lands, both by land and sea routes (Waekawa et al.2011: 248). Furthermore, specified amounts of copper was brought from Dilmun for the wife, of Enentarzi, another ruler of Lagash; copper from Dilmun in exchange for barley, flour, and cedar was brought for Lugalanda (Ratnagar 2003:86).

One of the probably earliest Akkadian texts from Ebla (Syria) mentions Dilmun as one of the geographical entities (Waekawa et al. 2011:246). Sargon of Akkad's (c.2300-2245 BCE) proud claim of the berthing of the ships of Dilmun, Magan and Meluhha has already become a byword for reference. Further, during the Akkadian period (c.2300-2159 BCE), a large labour force was working for the Dilmun ships at the dock of Lagash, and two Nippur texts record 'caulking' of Dilmun ships (Waekawa et al. 2011: 249), pointing to either building, or application or re-application of bitumen on the ships.

During the Ur III period (c. 2100-1900 BCE), the business transactions were carried out under state control, yet some of the merchants were occasionally investing their own money as well for profit. Mentioning his procurement expeditions, Gudea (c. 2090 BCE) 'claims that "great fear of my house hovers over all the lands" so that "all come to do his budding" "and transport copper to him as if it were grain" (Ratnagar 2003:87). Ratnagar also avers that, during the reign of Rim Sin (about 1820 BCE), merchants collected from investors silver, textiles and oil to get copper or "fish-eyes" from Dilmun. Waekawa and Mori (2011:253), however, observed the 'References to Dilmun drastically decrease in the administrative records of the Ur III period'. With the defeat of the last ruler of the Ur III, Ibbi-Sin (2013-1989), the trade between Mesopotamia and Magan collapsed and the merchants from the former transferred the "maritime trade" via Dilmun and the business ceased to be controlled by the state, instead the profits were distributed among those who invested in trade

(Weakawa et al. 2011:258). This was the time when the state of Isin (Modern Bahriyat) came in existence at the expense of Ur III.

'In early second millennium BC, the seafaring merchants of Ur once again navigated to the Dilmun (not to Magan) to import objects from the East' (Waekawa 2011:267) they further add, 'The role of Dilmun as a stopover point ultimately ended in the later half of the second millennium BC. In the later literary texts, the term Dilmun, together with Aratta, sometimes refer to something beautiful, without any concrete geographical meaning' (Waekawa et al. 2011: 267)

There are Old Babylonian Sumerian literary texts, such as *Curse of Agade, Enki and Ninhursag, and Enki and the World Order* and others which, albeit written in the 2nd millennium BCE, reflect historical facts bearing on the political relations with foreign lands and their export to Mesopotamia during the 3rd millennium BCE, more particularly Akkadian. Among several foreign lands Meluhha, Magan and Dilmun too occur. (Waekawa et al. 2011. 258-63): The *Enki and Ninhursag* says: 'May Dilmun become storehouse on the quay for the land'; exotic goods from foreign lands of Tukrish, Meluhha and Magan imported to Ur via Dilmun; and the city of Ur dispatched sesame, garments, and fine textiles to Dilmun in order to their onward transportation to other foreign lands. In the *Enki and the World order*, the god Enki proclaims, 'Let the land of Meluhha, Magan and Dilmun look upon me. Let the Dilmun boats be loaded with timber. Let the Magan boats be loaded with treasure. Let the *Magilum* boats of Meluhha transport gold and silver….”; fish and date palm are said to be the specialties of Dilmun; it mentions Dilmun as a stopover port, while not giving any information about Magan, but the exotic things of Meluhha are enumerated.

Ratnagar in his highly useful book (1981:23) has enlisted the products such as copper, silver, gold, carnelian, lapis lazuli, other semi-precious stones, ivory and ivory objects, “fish-eyes” or pearls, white coral, various wood and dates which were sent to Ur from Dilmun. Possehl (1996:147) rightly opines that the first seven items,

plus the dates may have come from Meluhha and/or Magan and ‘would not be found as a part of the Dilmun landscape’.

‘One gets a sense’, to quote Possehl 1996:147), ‘that Dilmun was the operational “nerve-Centre” for this early Gulf and Arabian Sea trade. It seems that it was the Dilmun merchants who generally dealt directly with their Mesopotamia colleagues on the one hand and their Magan and Meluhhan counterparts on the other. it seems impossible for one to understand the Mesopotamian/Meluhhan relationship without reference to Dilmun’.

Waekawa and Mori (2011:266, cf. 265 as well) have diligently tabulated the different minerals, their sources of import, as they occur in various old Babylonian literary compositions, including the Gudea inscriptions. According to the *Enki and the World Order*, Meluhha was the source for copper, tin, bronze, gold, silver and carnelian; in respect of copper, Magan is the source in the *Enki and Ninhursag* and the Lipsur litanies; For gold, reference is found in a Gudea inscription too, so is the case for gold, silver, two kinds of stones, one of which has been identified to be diorite for which Magan is said be the source in the *Enki and Ninhursag*; in the *Exploit of Ninurta* and in a Gudea (which mentions Meluhha too in this respect) inscription of Lagash, belonging to Ur III period; the same is summarized here: and further in this regard a citation is made to the Iranian highland too; for lapis lazuli, Ninurta G” too refers to Meluhha as the source; However, for carnelian, all epigraphical and literary compositions, six in number, only Meluhha is cited as the source; the reference to lapis lazuli as an item to be coming from Dilmun as per the *Enki and the World Order* and the *Enki and Ninursag*, perhaps, point to a condition that prevailed in early 2nd millennium BCE when the Indus trade had declined and a north-south route has opened up linking from Margiana and Bactria to the Strait of Hormuz and onward to Oman through Bahrain.

10.10.3 The Wadi Sug culture (c.2000-1800 BCE) and external relations

By the turn of the second millennium BCE, the Wadi Suq culture homogeneously spreads all over the Oman peninsula from its eastern to western coastlands; it is represented by its own painted pottery, copper tools and "serié récente" steatite vessels; most remarkably, the Harappan ware pottery is ubiquitous, almost at every site 'by reaching a diffusion attained by any foreign material in the country' (Cleuziou et al. 1989:40). The entire Oman peninsula was densely populated as far as the Masira island. Quoting Sumner and Jacobs, the authors state, 'Like Wadi Suq in Oman, the City II assemblage of Bahrain evenly spreads along the coast and islands of Eastern Arabia, and the Kaftari culture appears to be the unifying complex of southern Iran east of the Susiana lowlands (Cleuziou 1989:40) (Zarins 1989:81-83).

The série récente vessels are mainly bowls which are decorated with double dot-in circle between two lines incised below the rim. These may be compared to a bowl from room VIII, house 3 in DK-B area of Mohenjo-daro (fig. 10.16A) and to one from stage VI context from Dholavira (fig 10.16B) which, however, also yielded another incised piece from the same cultural context at Dholavira (fig 10.16c). Temporally, these may be compared to two stamp seals from Lothal where those are from the surface levels and can be dated to the turn of the 2^{nd} millennium BCE (fig 14) As late as that the contacts with Oman and the Gulf were live. Such série récente vessels are found widely distributed in the entire region and beyond.

This is the time when the Central Asian stemmed bowls, cups, copper ornamental pieces and a few other items such as cylinder seals are found spread from Mehrgarh, Nausharo in India, and Iran and the Gulf region. Exotic objects, including seals, copper axe-adge are reported from other sites, including Mohenjo-daro. Late pottery forms have been recovered from the graves and sub-surface layers from as far at Dholavira.

Thus, cultural territories of the Indus, the SE Irano-Oman and the western Gulf conjure up a vibrant picture of maritime international trade that respectively involved the ancient worlds of Meluhha, Magan and Dilmun in connection with nighty Mesopotamia which alone provided a plethora of wealth of textual and archaeological materials for the later half of the third millennium BCE. The trade also spilled over into the first two centuries of the second millennium BCE when the contacts with Harappania waned and then ceased, but the Bactria-Margiana archaeological complex of Central Asia was gaining strength as it belatedly witnessed a spurt of urbanization with some bright flashes, however sans literacy that marked the Harappan and Mesopotamian civilizations.

Notes

1. Many archaeologists have now begun to call the latter as Arabian Gulf for no other considerations than diplomatic, but we would better refer to it simply as the Gulf.
2. It is the same cultural assemblage which was wrongly dated by Sir Aurel Stein to the 2nd millennium BCE on the basis of his hurried excavation “without any real stratigraphical observations” and on the facile comparison of some objects with those from other sites of a later date.
3. Harappania is a term coined by me for the consideration of the scholarly world. This is done because we always otherwise to express the area as Indus territory, Indus region, Indus land(s), etc.
4. Dates of Mesopotamian chronology as given herein after generally accord with those followed in Aruz et al. edited volume 2003.

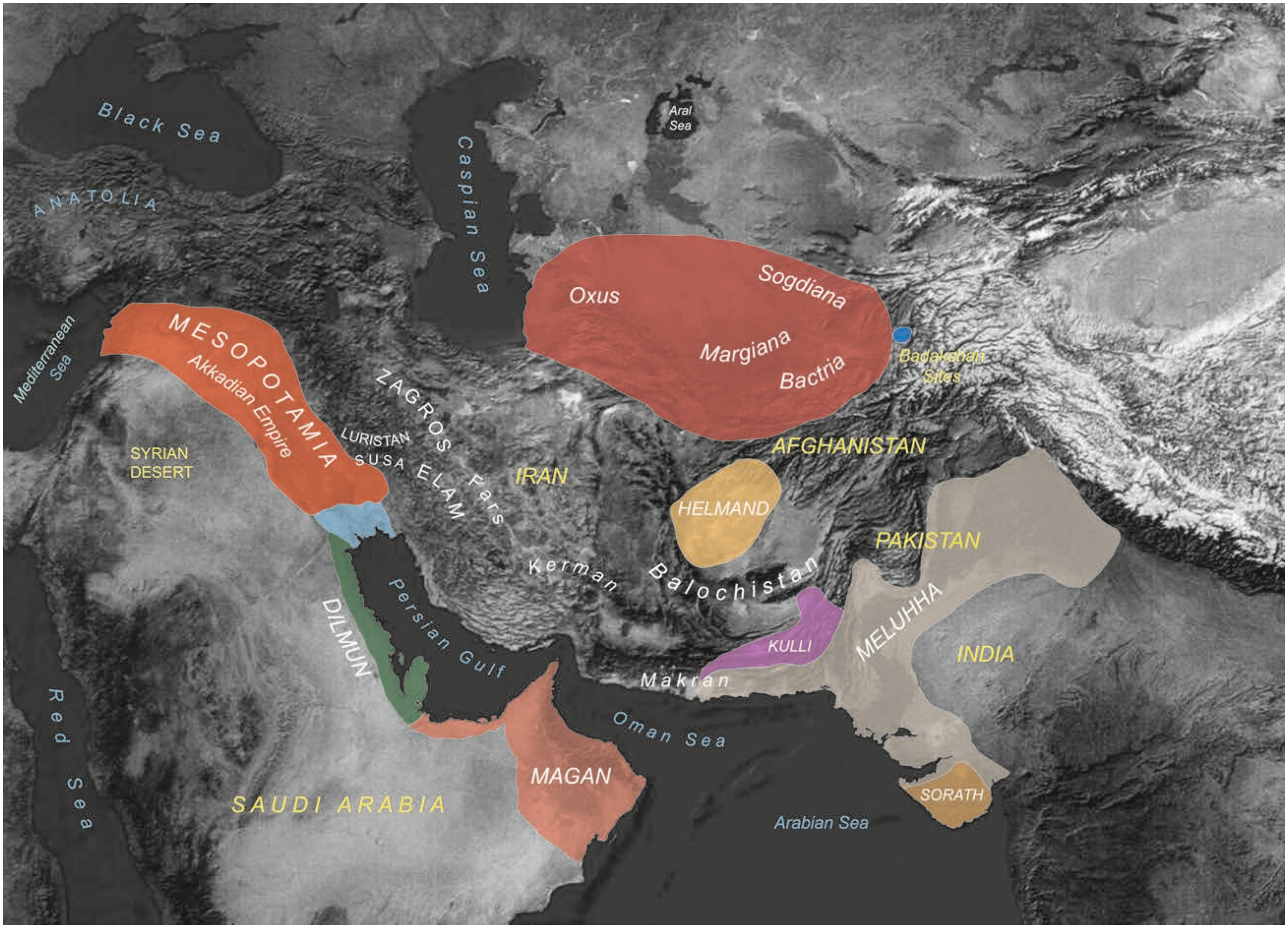


Fig. 10.1 Map showing intercultural interaction sphere during third / early second millennium BCE



Fig. 10.2: Etched carnelian and agate beads from Harappania



Fig. 10.3: Long carnelian beads of Harappan workmanship

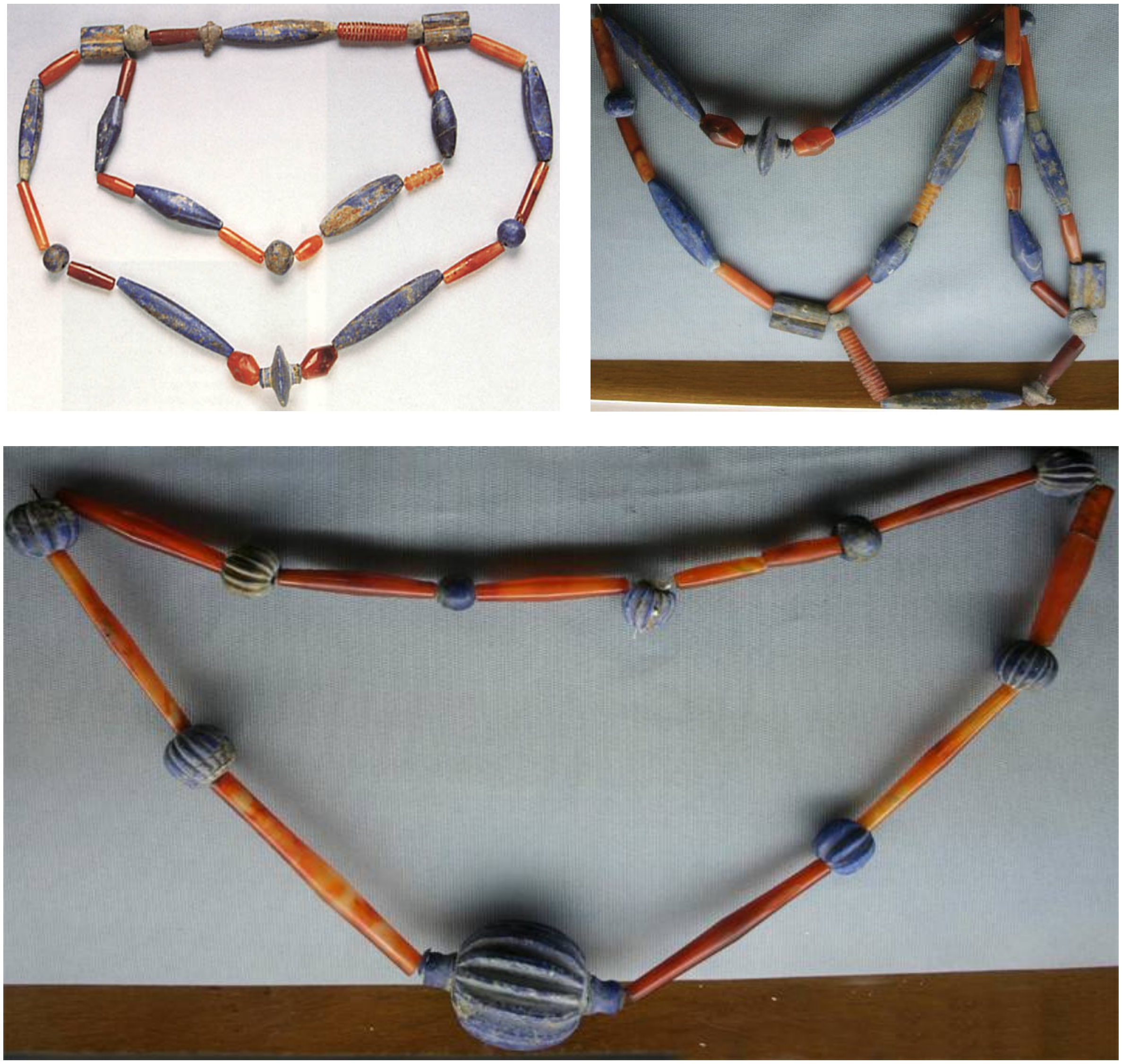


Fig. 10.4: Strings of long carnelian and lapis lazuli beads from the Mari treasure.


Fig. 10.5: A vase of Reserved Slip Ware from the Mari treasure

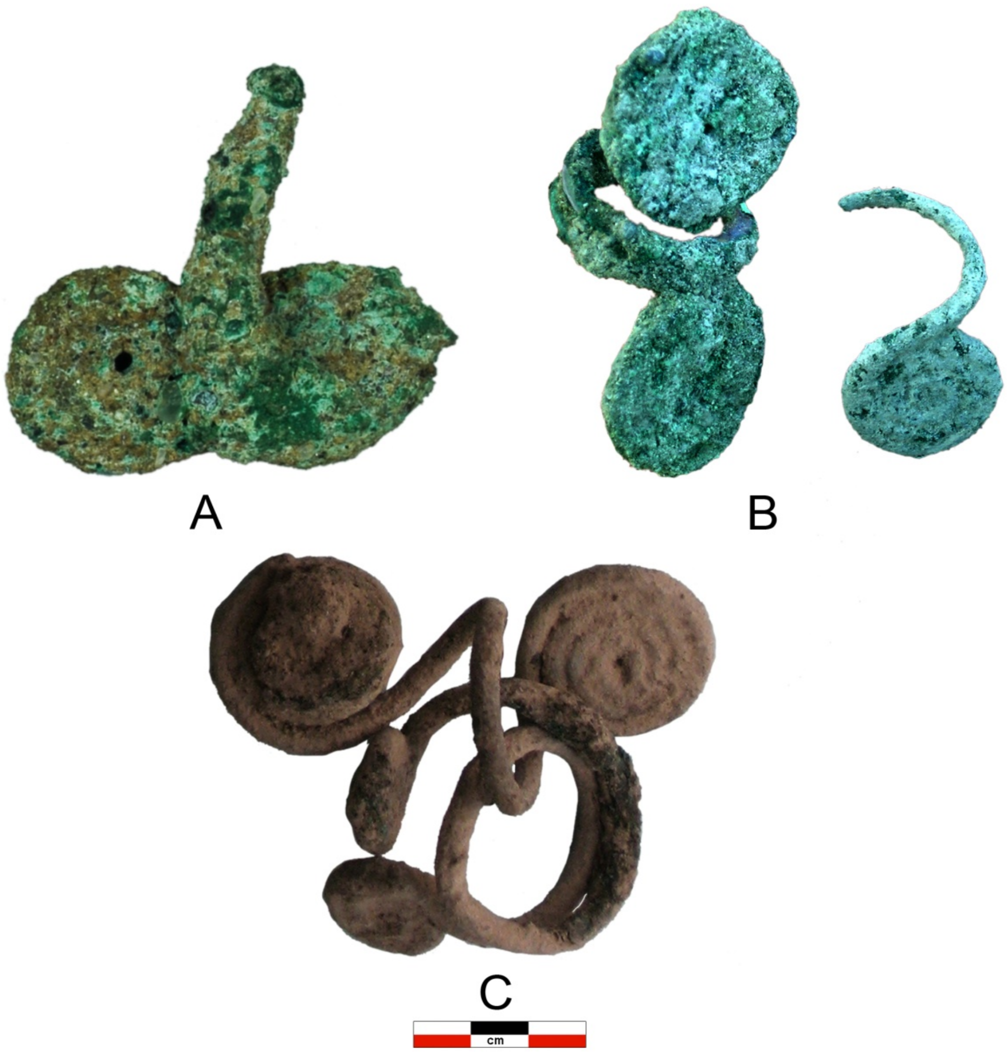


Fig. 10.6: Spiral ornaments of copper from late phase of Harappan culture (late 3rd/ early 2nd millennium BCE:

A. Dholavira (Kachchh), B and C Pithad (Saurashtra).
B & C by Courtesy : Department of Archaeology, M.S. University Vadodara

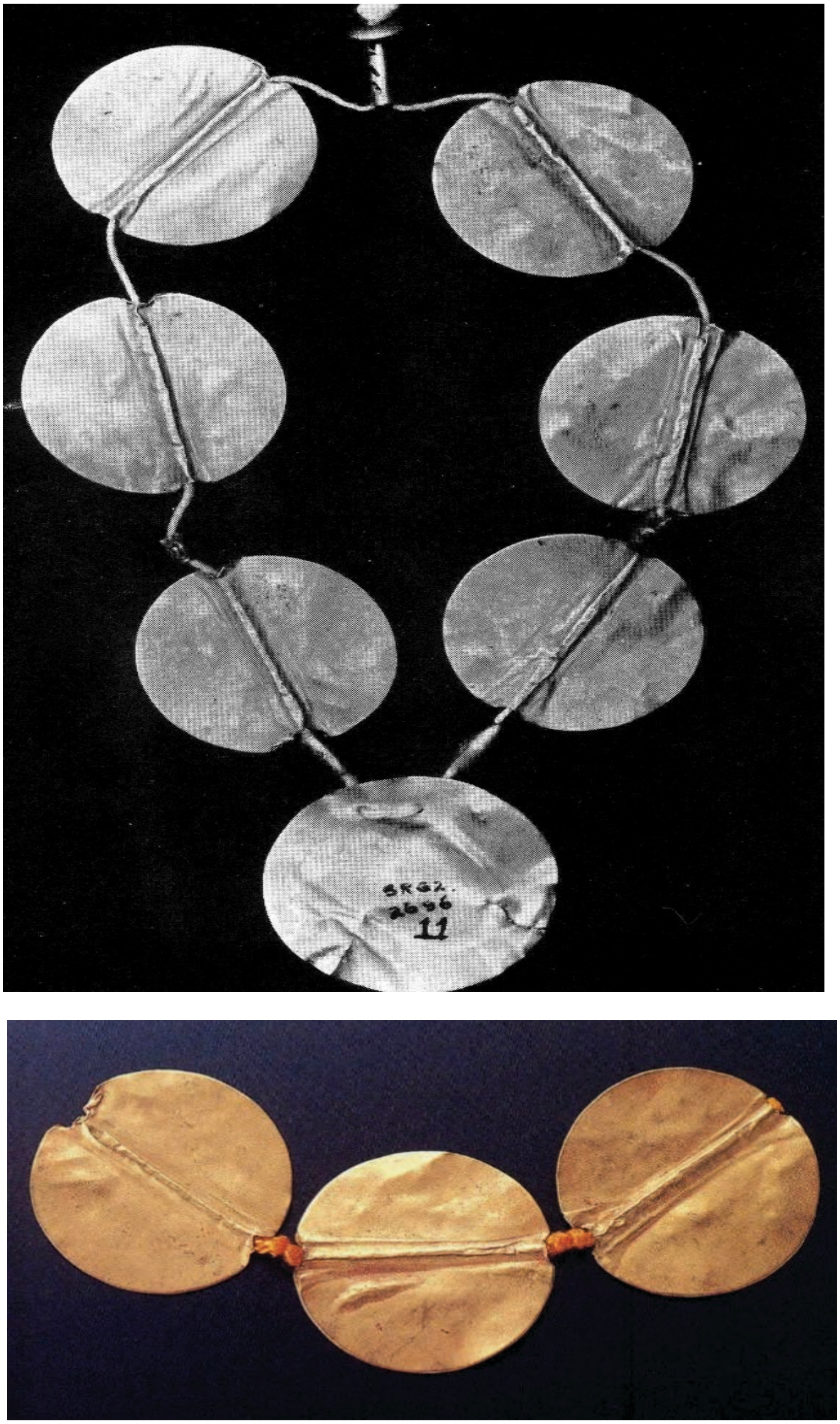


Fig. 10.7: Disc beads of gold and silver with tubular hole from Lothal



Fig. 10.8: Trefoil design on the cloak of the statuette from Mohenjo-daro

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Fig. 10.9: Harappan tablet showing a hero fighting

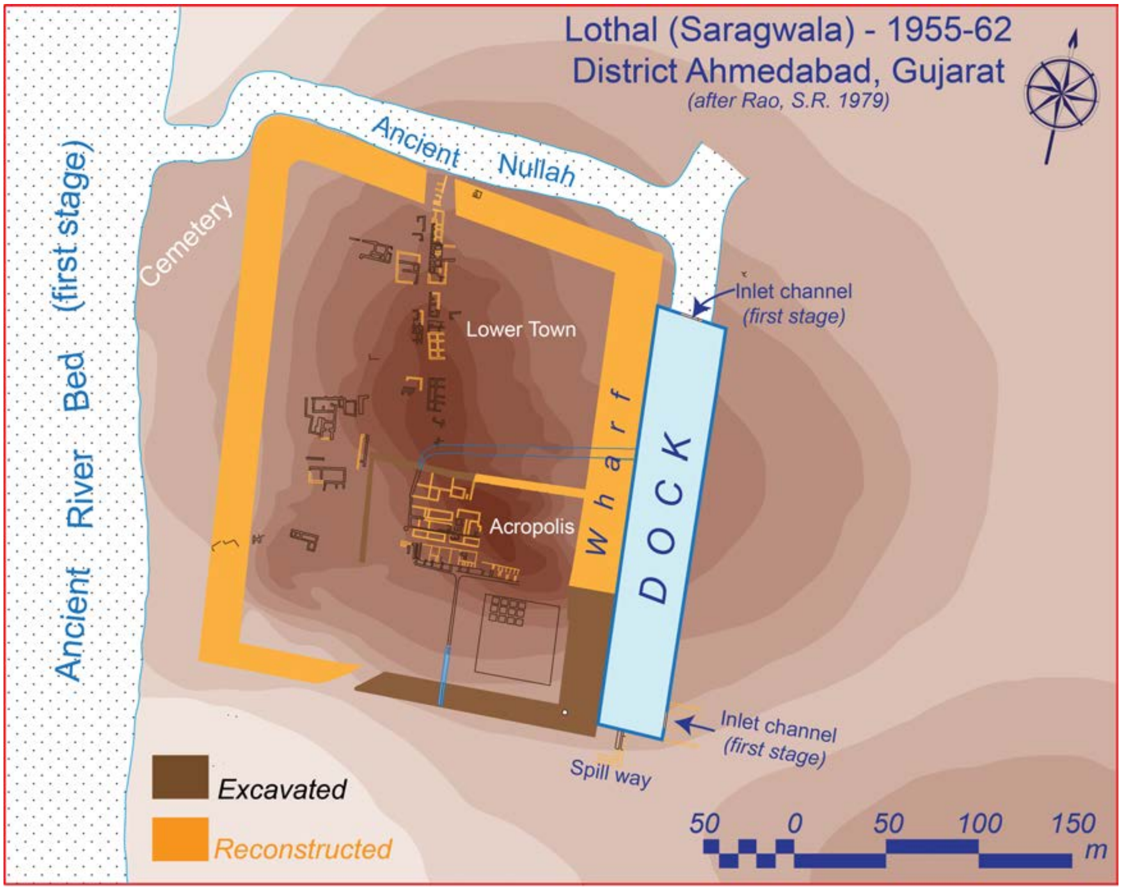


Fig. 10.10 A: Site plan of the Harappan Town of Lothal



Fig. 10.10 B: An artistic conjectural view of Lothal



Fig. 10.11: The Harappan dock at Lothal.



Fig. 10.12 A: Depiction of boat / ship from Mehenjo-daro on a trifacial TC tablet



Fig. 10.12 B: Depiction of boat / ship from Mohenjo-daro on a seal



Fig. 10.13: Three views of “Persian Gulf seal” from Lothal.



A.



B.

Fig. 10.14: Omani-like seals from Lothal.



Fig. 10.15: Copper ingot from Lothal

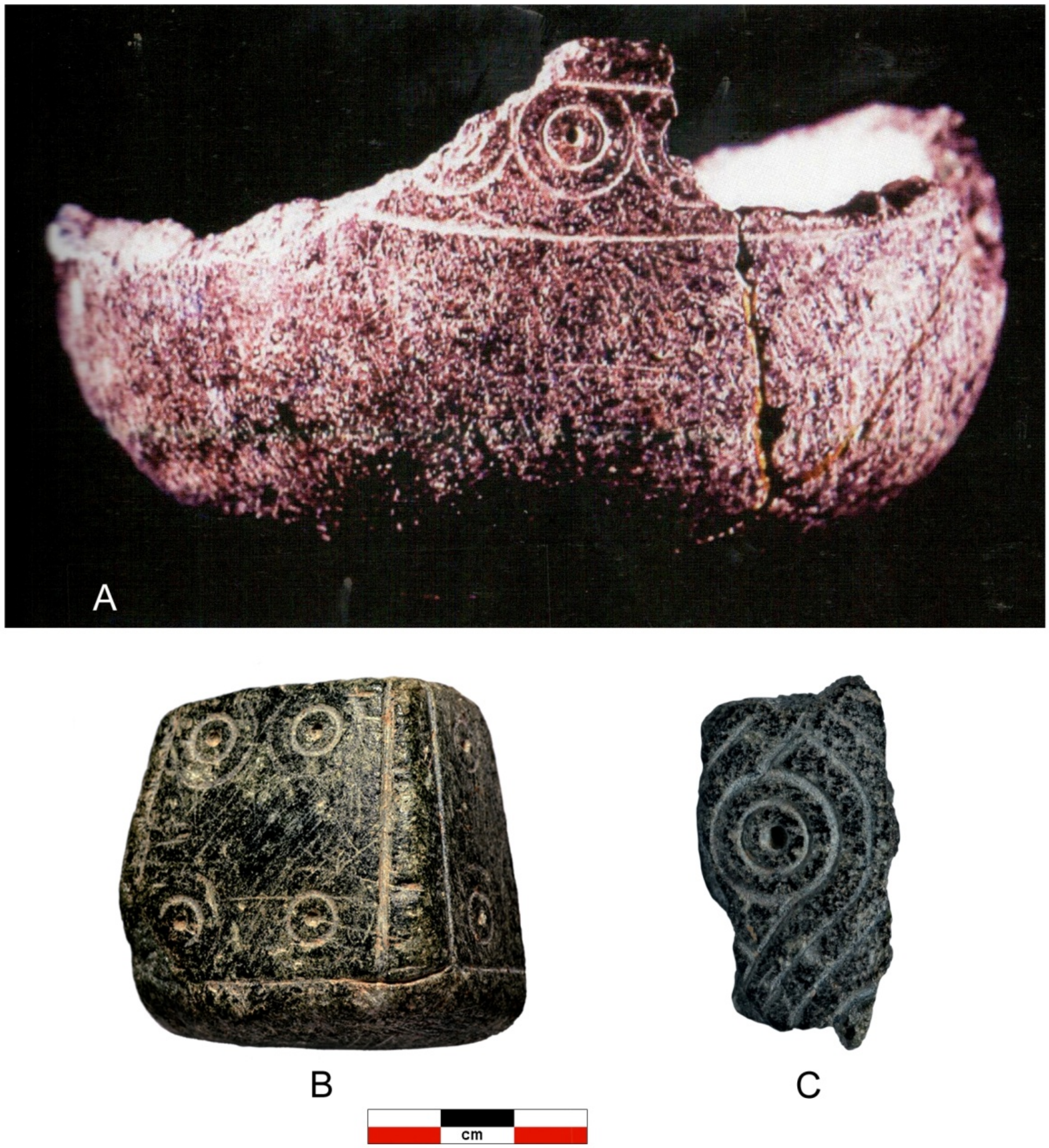


Fig. 10.16: Steatite Vessels from late levels of Harappa culture (late 3rd/ early 2nd millennium BCE) A:- Mohenjo-daro, B and C Dholavira.



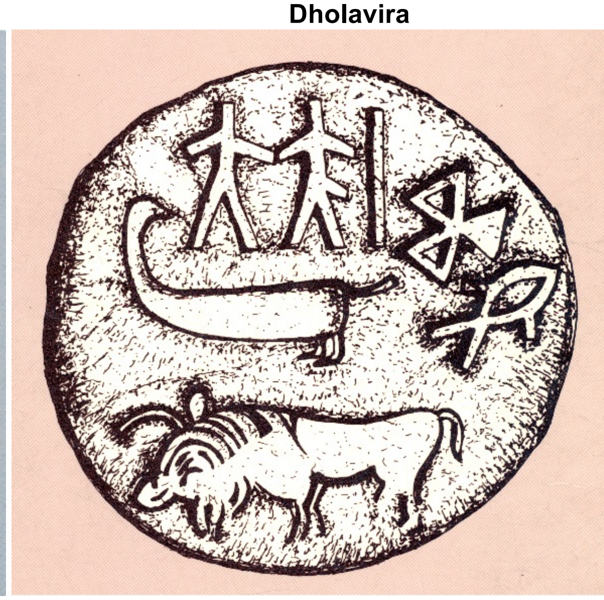
Susa



Dholavira



Qalata- Bahrain



Hamad, Bahrain

Fig. 10.17: Round seals of Gulf type with Indus motifs and inscriptions

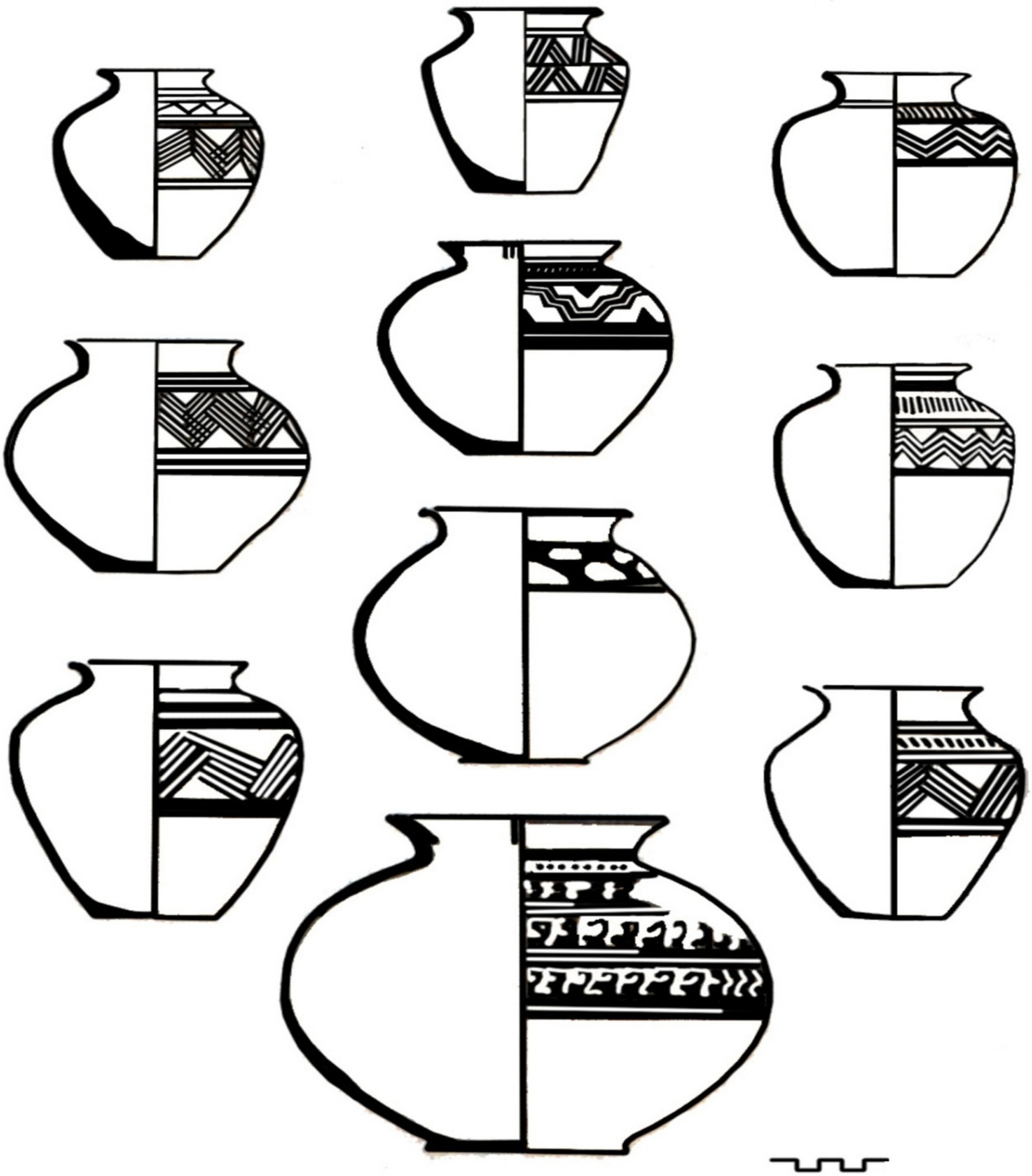


Fig. 10.18: Fine black-on-red ware painted pottery from the Umm an- Nar graves (after Hélène David)

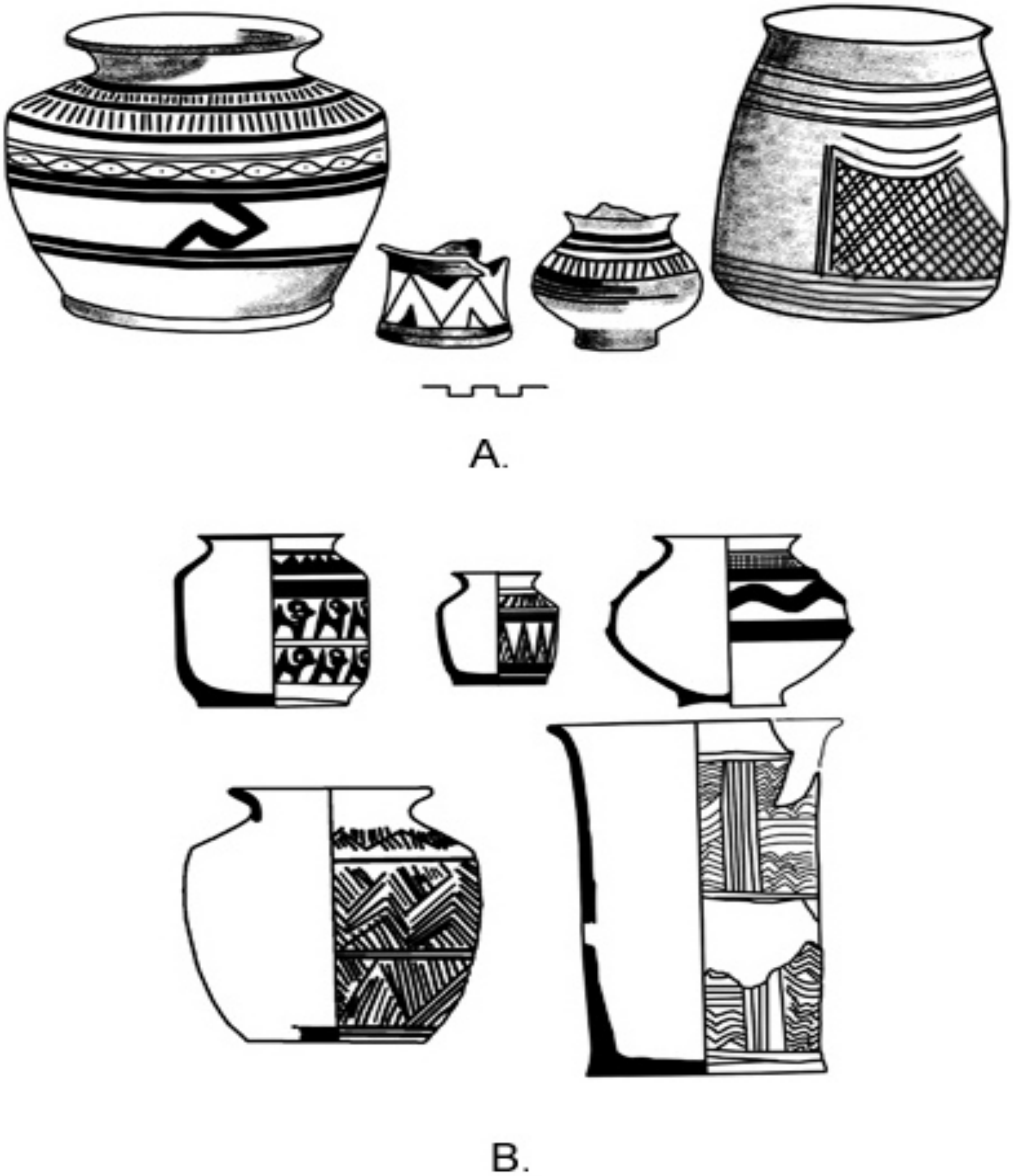


Fig. 10.19 A: Painted grey ware and incised grey ware pottery of SE Iran and Makran affiliation from tomb A at Hili North (c.2300-2100 BCE) (drawn from photo French Archaeological Mission to Abu Dhabi)

10.19 B: Painted an incised grey ware pottery from the tombs at Umm an- Nar, mid-3rd millennium BCE (after Hélène David)

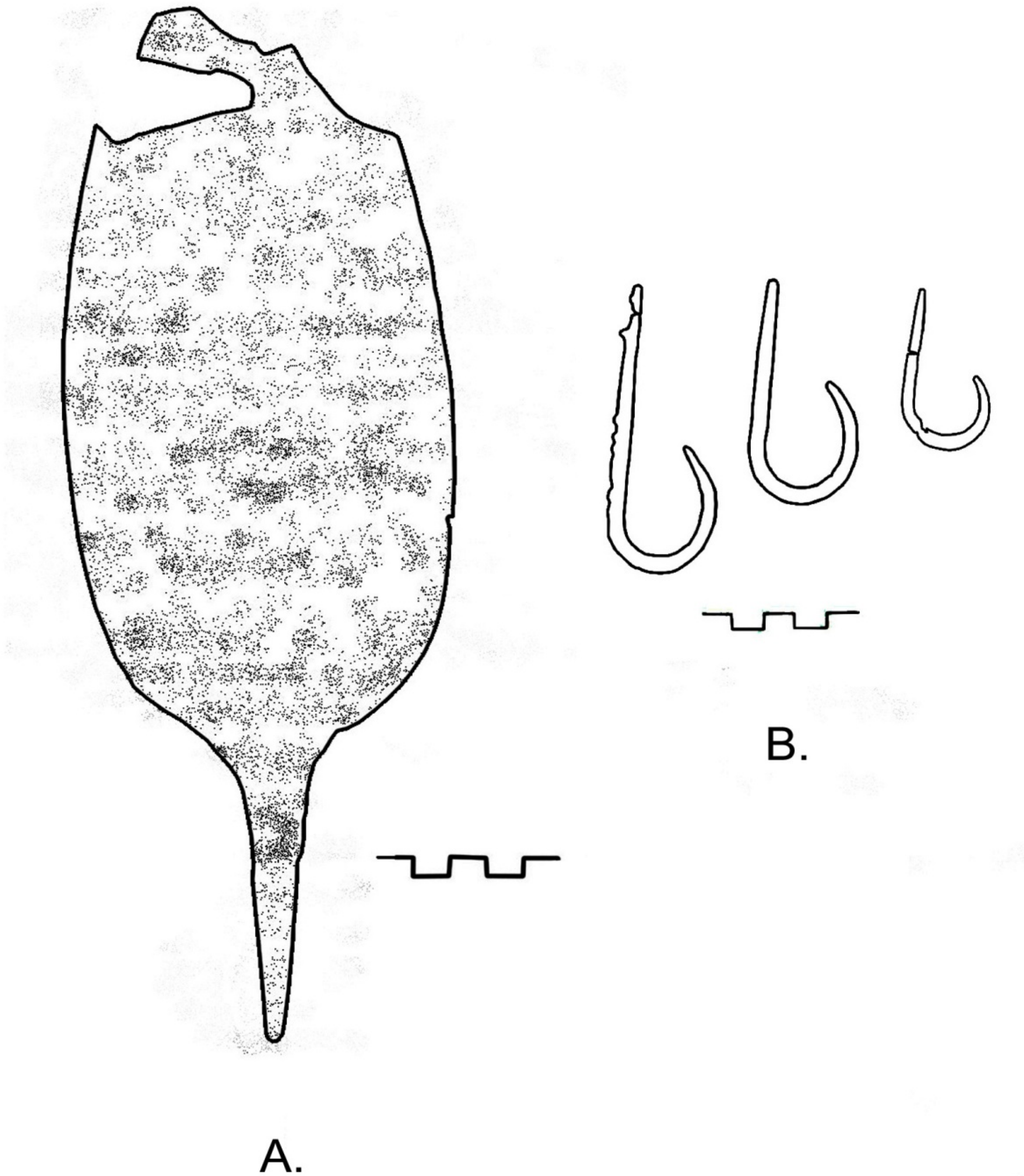


Fig. 10.20: A. Harappan-like spear-head from surface at Suwayh SWY-3; B. Copper fish-hooks from Ra's al-Jinz, out of 100s of examples from the site. Harappan fishhooks are also the same (both after Joint Hadd Project).

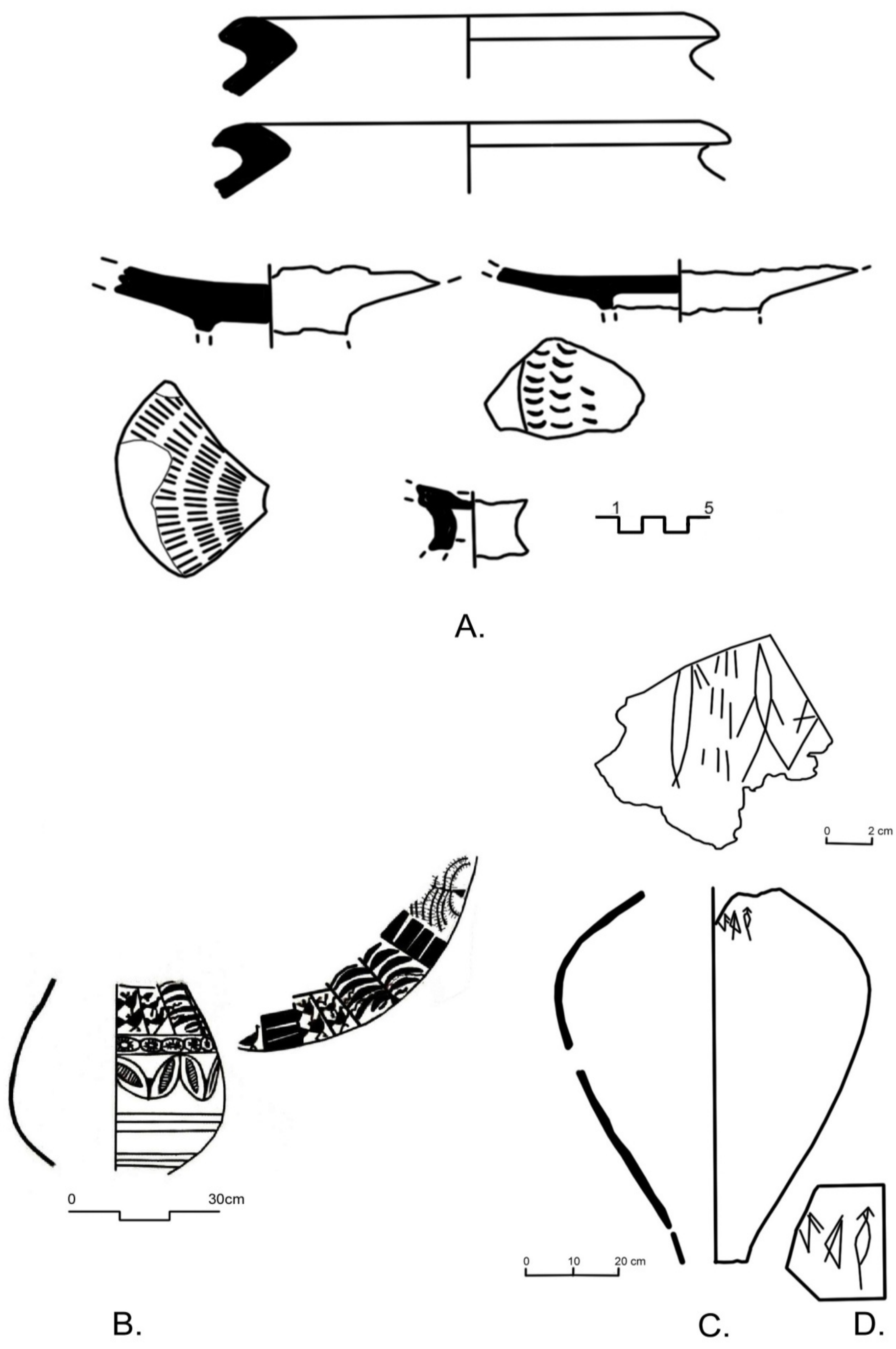


Fig. 10.21: Harappan ware pottery, A. Jar and dish-on-stand fragments from Hili 8, periods IIc-IId (c. 2500-2400 BCE) (after Philippe Gouin) ; B. Part of S-shaped jar from Ra's al-Jinz (c. 2500-2400 BCE) (after Helene David); C. Top one, a red ware sherd bearing Harappan writing from the surface of RJ-2 at Ra's al-Jinz ; lower one, an inscribed black slipped jar (24th century BCE) from Ra's al- Jinz; D. An inscribed rim sherd from an Indian site (B-D after Cleuziou et al.2007 : fig 176)



Fig. 10.22: Indus black slipped jar.

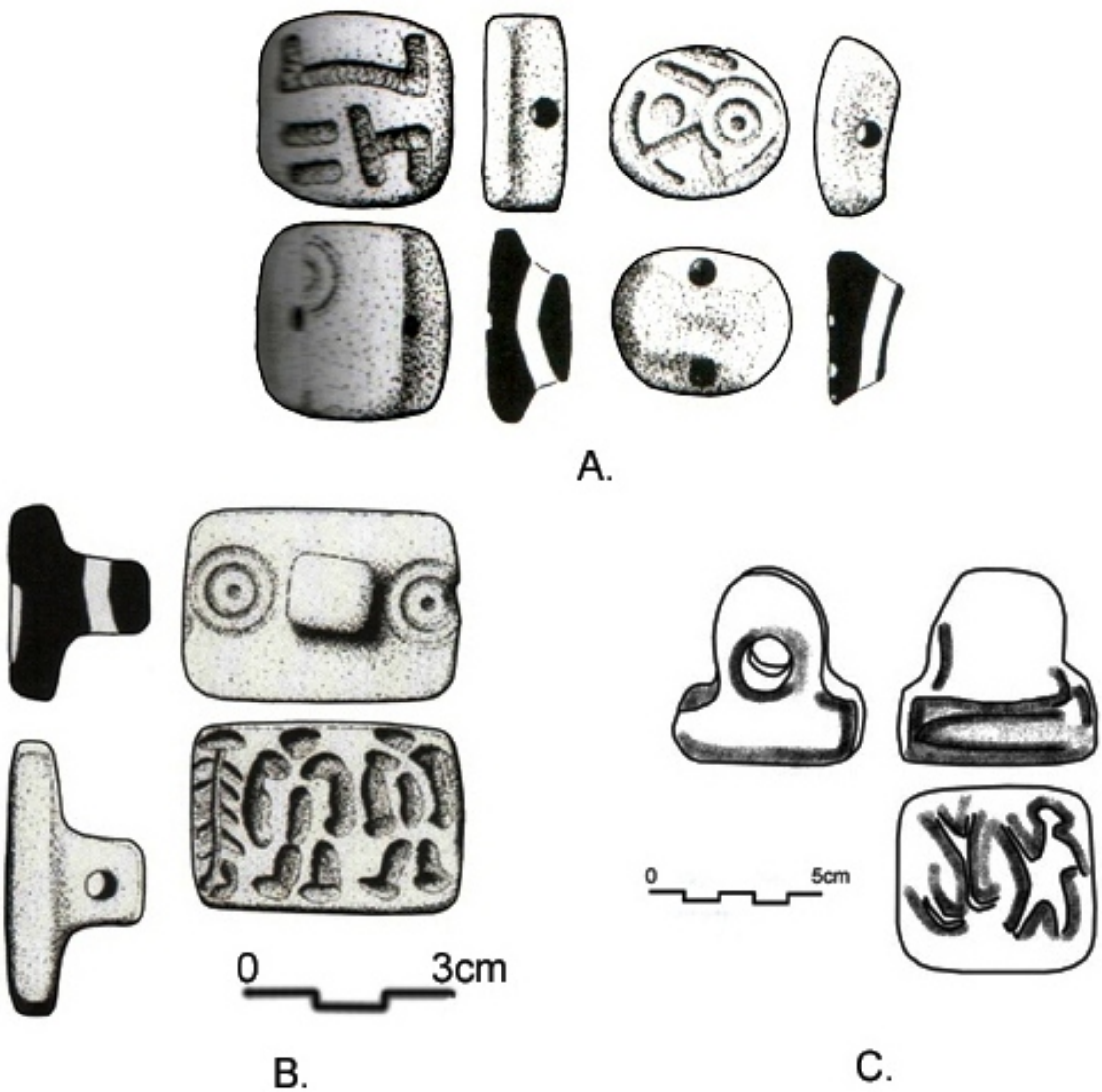


Fig. 10.23: Omani-type steatite stamp seals from Ra's al- Jinz : A & B from building VII, datable to c. 2200 BCE; C. From grave 1 at RJ-1, Ra's al- Jinz, dated to before 2400 BCE (all after Joint Hadd Project).

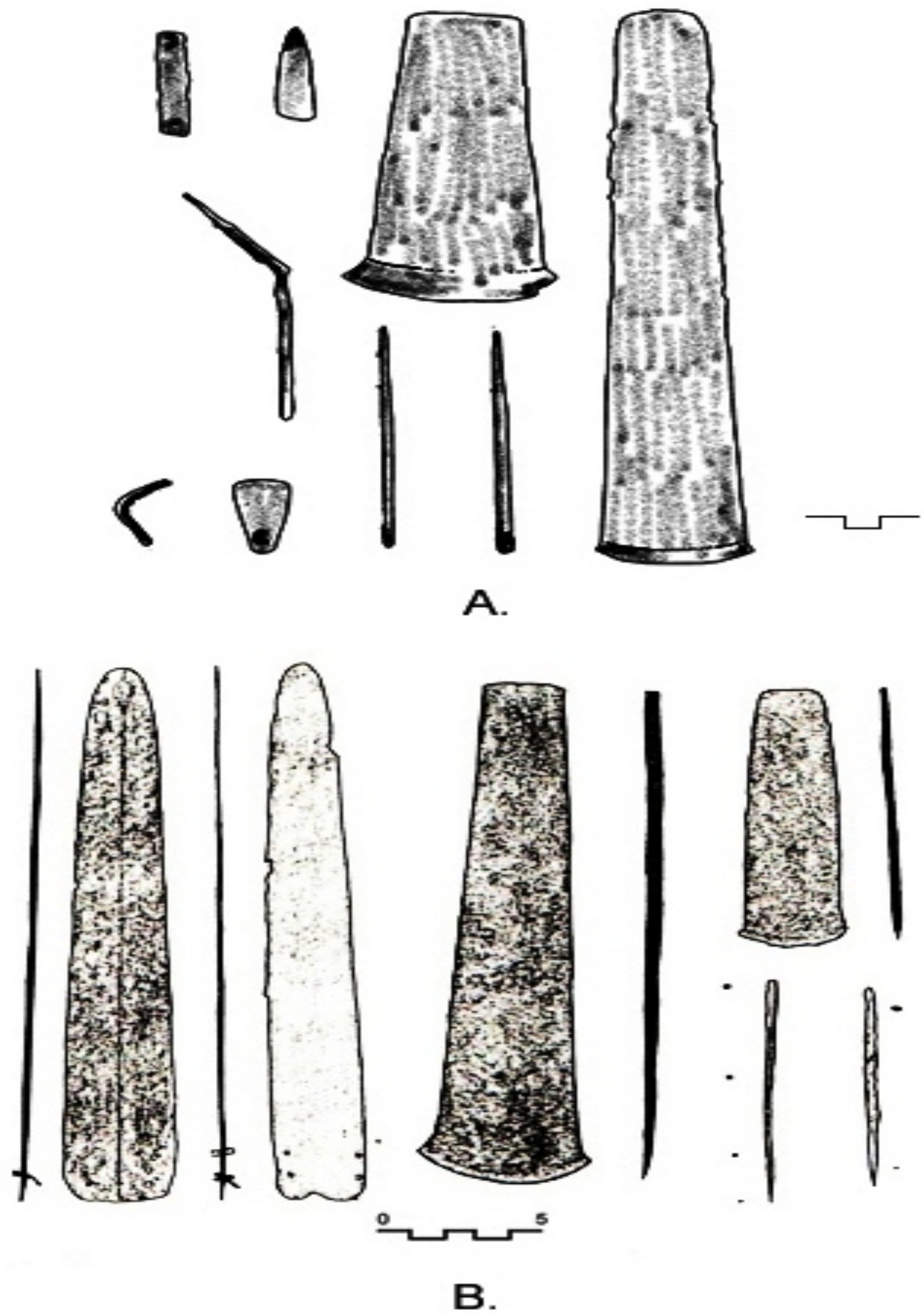


Fig. 10.24 A. Copper tools from Al-Moyassar: such tools are found in the Harappan assemblage (after German Mining Museum at Bochum); B. Barring the first, the rest may b seen in the Harappan assemblage, the first is, however, close to one from post-Harappan Copper Hoard tools (after Benton 1996)

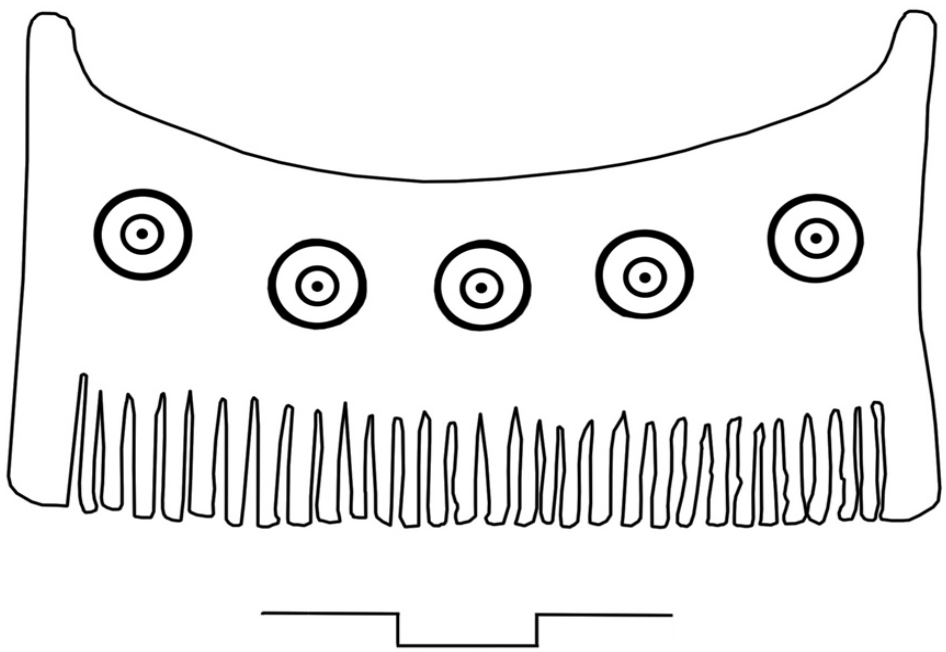


Fig. 10.25: An ivory comb from Ra’s al- Jinz (c. 2400 BCE).

Chapter 11

11.1 Identification and analysis of stones and metals

Randall W. Law

11.1.1 Introduction

Artifacts from Dholavira recovered during excavations by Dr. R. S. Bisht and the ASI at the ancient city of Dholavira, District Kachchh, Gujarat, provide an invaluable set of data for understanding the origin and character of this city and its relationship to other cities and settlements of the Indus civilization. Because of the large scale of excavation and the recovery of materials from all major chronological periods as well as from many different parts of the site, this assemblage has the potential to provide a unique perspective on the development of technology, trade and exchange as well as specific patterns of urban organization. Unlike excavations conducted at Mohenjo-daro and Harappa in the 1920s and 30s.

The artifacts collected from Dholavira were recovered through careful stratigraphic excavations and spatial documentation. Recent excavations at the site of Harappa, Pakistan conducted by the Harappa Archaeological Research Project have a comparable collection of artifacts excavated with careful stratigraphic control and also dating to the same general time period.

The artifacts from Harappa have been documented by Dr. J. Mark Kenoyer, Dr. Richard Meadow and their students using the most recent scientific techniques and analysis. After many discussions with Dr. R. S. Bisht and officers at the ASI, Dr. Kenoyer and Randall Law arranged to assist with the documentation and analysis of the Dholavira artifact assemblage in order to make it possible to engage in more detailed comparative studies between these two important sites. Approval for this collaborative project was provided by the

ASI (Letter from Dr. R. S. Fonia, Director, Exploration and Excavation, ASI, dated 26 April 2007).

11.1.2 Studies at Purana Qila

Excavated materials housed in the Dholavira section of Purana Qila, New Delhi were studied (Figures 1 and 2) in collaboration with Dr. R. S. Bisht, V. N. Prabhakar, Nayan Chakraborty, Sangita Charaborty, and other staff members for various periods of time in 2007 and 2008. Dr. J. Mark Kenoyer was specifically involved in the recording and documentation of stone beads and artifacts related to bead making, while Randall Law was involved in the identification of raw materials from all categories of items, including stone and metal objects.

In order to undertake this type of study a new computer and scanner, as well as and external hard drive and CDs for storing the data were donated to the Dholavira section with funding provided by Global Heritage Fund, Palo Alto, California. In addition, a binocular microscope, digital microscope, lamps, and supplies for proper storage and conservation of the artifacts were provided by GHF and Kenoyer. Expenses relating to the analysis of the raw material samples were provided by Kenoyer and Law.

High resolution (600 to 2400 dpi) scans were made of the registered artifacts and digital photographs were made to document specific artifacts. Select examples of unregistered raw material and production debris were also scanned. A binocular microscope and a Dino-Lite Digital Microscope were used to examine and document minute details on some artifacts. Weight and dimension measurements were recorded using a precision scale and digital calipers.

When material density could provide clues as to an artifact's composition, density measurements were made using a precision scale and a hydrostatic specific gravity device. Special casting materials were used to make impressions of drill holes in beads and also some of the seals that were first conserved and properly consolidated.

Data generated through the documentation process were recorded using recording procedures designed according to each artifact type, based on formats used at the site of Harappa, with some modifications for specific features of the Dholavira assemblage. The recorded data was entered on both hard copies and in Excel spreadsheets on the computer. Original versions of these spreadsheets, along with all scans and photographs, were placed on the Dholavira section's main computer. These spreadsheets and images were also backed up to DVDs, copies of which reside in the Dholavira section and the office of the Exploration and Excavation Branch, Archaeological Survey of India, Janpath.

11.1.3 Seals

Exactly 176 identifiable seals (complete and broken) and non-diagnostic fragments that may be remnants of seals were examined (Figure 11.1).

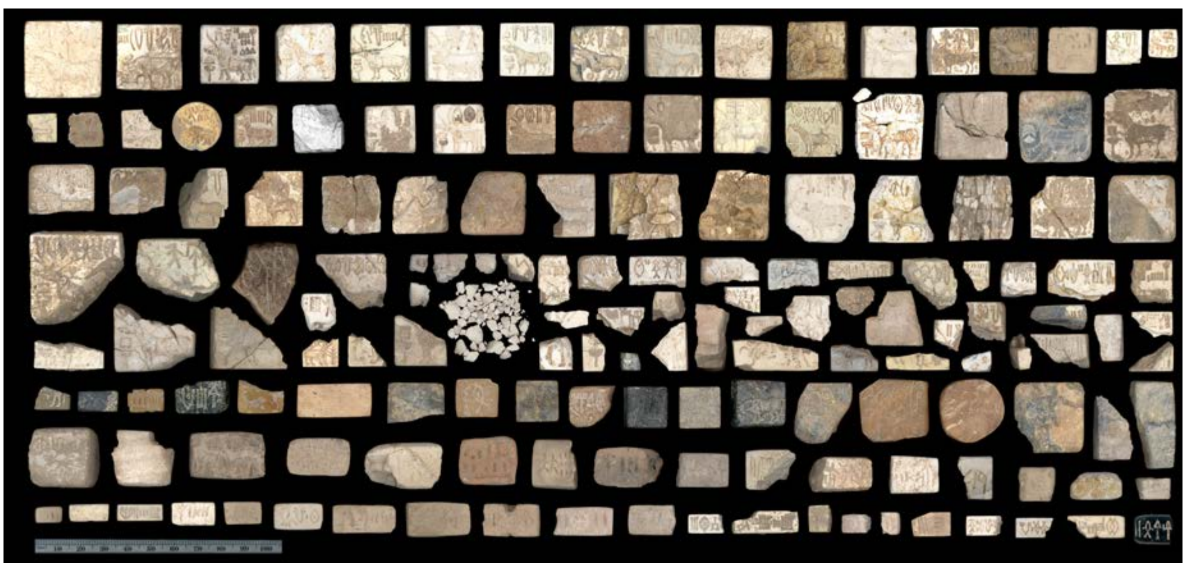


Figure 11.1: Composite image of seals in the Dholavira section, Purana Qila, New Delhi

The majority had been manufactured using the classic Harappan technique, i.e. – they had been carved from a solid block of steatite, their surfaces had been whitened (possibly by the application of either an alkali bleach or a thin talc glaze), and they had been subjected to varying degrees of heat treatment. Some of these seals had been heated completely through but most were partially heated leaving the steatite of the interior unaltered.

Inspection of their unaltered interiors, as well as examinations of the unfinished seals in the corpus, indicated that several visually distinct varieties of raw steatite were used (black, khaki, gray, and green being the most common). A somewhat schistose grayish variety was noted for its resemblance to steatite occurring in northeastern Gujarat. However, the geologic provenance of such material cannot usually be determined based on macroscopic qualities alone. In an effort to identify the steatite sources to which residents of Dholavira had access, INAA of a set of 29 artifacts was conducted at the University of Wisconsin-Madison (see below).

A sizeable minority of seals from Dholavira were fashioned from a light-weight stone having a grayish to off-white appearance and minute dark-colored inclusions. Thought initially to be a form of volcanic tuff, subsequent analyses of samples of this material at the University of Wisconsin-Madison (see below) indicated that it was primarily kaolinite and that the inclusions were igneous in nature (probably a hornblende mineral).

It is possible that this material occurs in the vicinity of Dholavira on Khadir Island. This has yet to be confirmed, however. Like steatite seals, the surfaces of many of these kaolinite seals appeared to have had been deliberately lightened, possibly using an alkali bleach. Seals composed of copper, marine shell, limestone, black jasper, faience and ivory are also present in the corpus.

11.1.4 Weights

Nearly 250 objects that had been registered as “weights” were examined and recorded (Figure 11.2). Around 45 of these may have been erroneously classified as they had unusual shapes (asymmetrical, flat rectangular, triangular, etc.) and/or were made from materials (such as hematite, marine shell and terracotta) that are not typical of weights found at Harappan sites. Regardless, all artifacts listed as “weights” were weighed on a precision scale by R.S. Bisht and Randall Law in order to determine if they conformed to the Harappan standardized weight system.

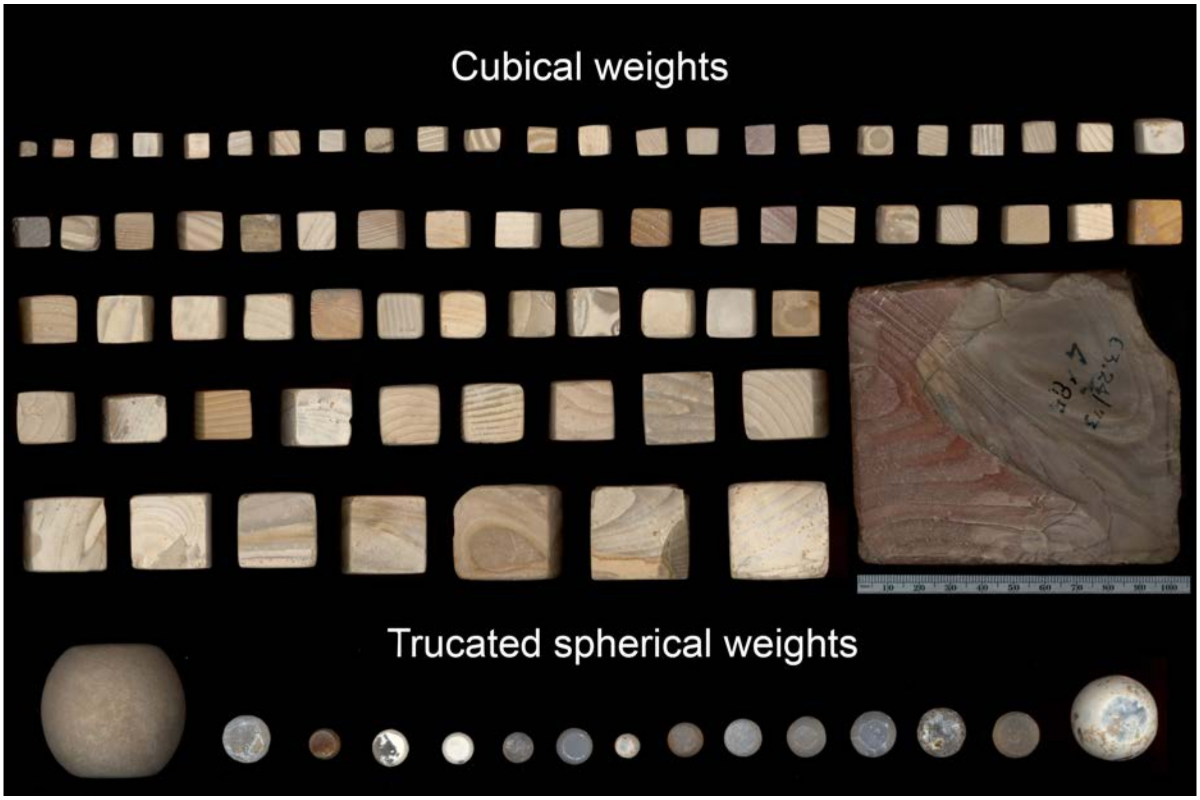


Figure 11.2: Composite image of stone weights in the Dholavira section, Purana Qila, New Delhi

11.1.4.1 Cubical weights

There are 95 cubical weights in the collection made from gray-brown chert. The majority of these exhibit a concentric banding pattern, which indicates that they are almost certainly from the Rohri Hills of Sindh – the only known source of chert in South Asia with this distinctive pattern. There are also 30 cubical weights made from igneous rocks (such as basalt and gabbro), 15 from agate, 19 from sandstone and 12 from limestone. All of these materials are available in the Kachchh region.

11.1.4.2 Truncated spherical weights

Thirty-two so-called "Gulf-style" truncated spherical weights were recorded. All were fashioned from materials available in the Kachchh region. Twenty-four were made of agate while the remaining ones were composed variously of basalt, gabbro, limestone, sandstone and quartz crystal. Additional

examples of this type of weight have been found among artifacts recorded as bead blanks, and it is possible that this sample size will be much larger once all the artifacts have been recorded.

11.1.5 Stone beads

The manufacture of stone beads at Dholavira appears to be an industry that was important for the economic organization of the city. The location of several distinct areas with accumulations of stone bead making debris along with caches of semi-finished and finished beads provides an opportunity to study the nature of bead production at the site and to document how it changed over time. In this preliminary report, we will present a general overview of the bead industry and the identification of the major raw materials used in bead making at the site. Finished, heat-treated steatite beads, comprise the bulk of Dholavira's bead assemblage. Due to the limited available for this study, steatite beads were not examined, but they will be studied in the future. The main focus of this study has been to examine other stone beads and manufacturing debris and record the full range of material varieties present. Out of an estimated sample of over 3000 objects, around 1800 artifacts – finished beads (complete and broken), partially drilled beads, bead blanks and roughouts – were examined for purposes of identifying the raw material. Of these, 628 finished and unfinished beads were carefully recorded to document their shape, size and manufacturing process. The general types of bead raw materials are listed below. A separated discussion of the beads and their features will be completed following the final recording of all the beads.

11.1.5.1 Agates & jaspers

Beads made from microcrystalline silicates (Figure 11.3) comprise the majority of non-steatite beads at Dholavira. This includes those broadly classified as translucent or semi-translucent agates (carnelian, chalcedony, chrysoprase, onyx, yellow agate, brown agate, green agate, moss agate and banded or mottled varieties that are mixtures of these), opaque jaspers (in solid, banded or

mottled red, brown, yellow, green, black and other shades including the variety called bloodstone), and mixtures of the two.

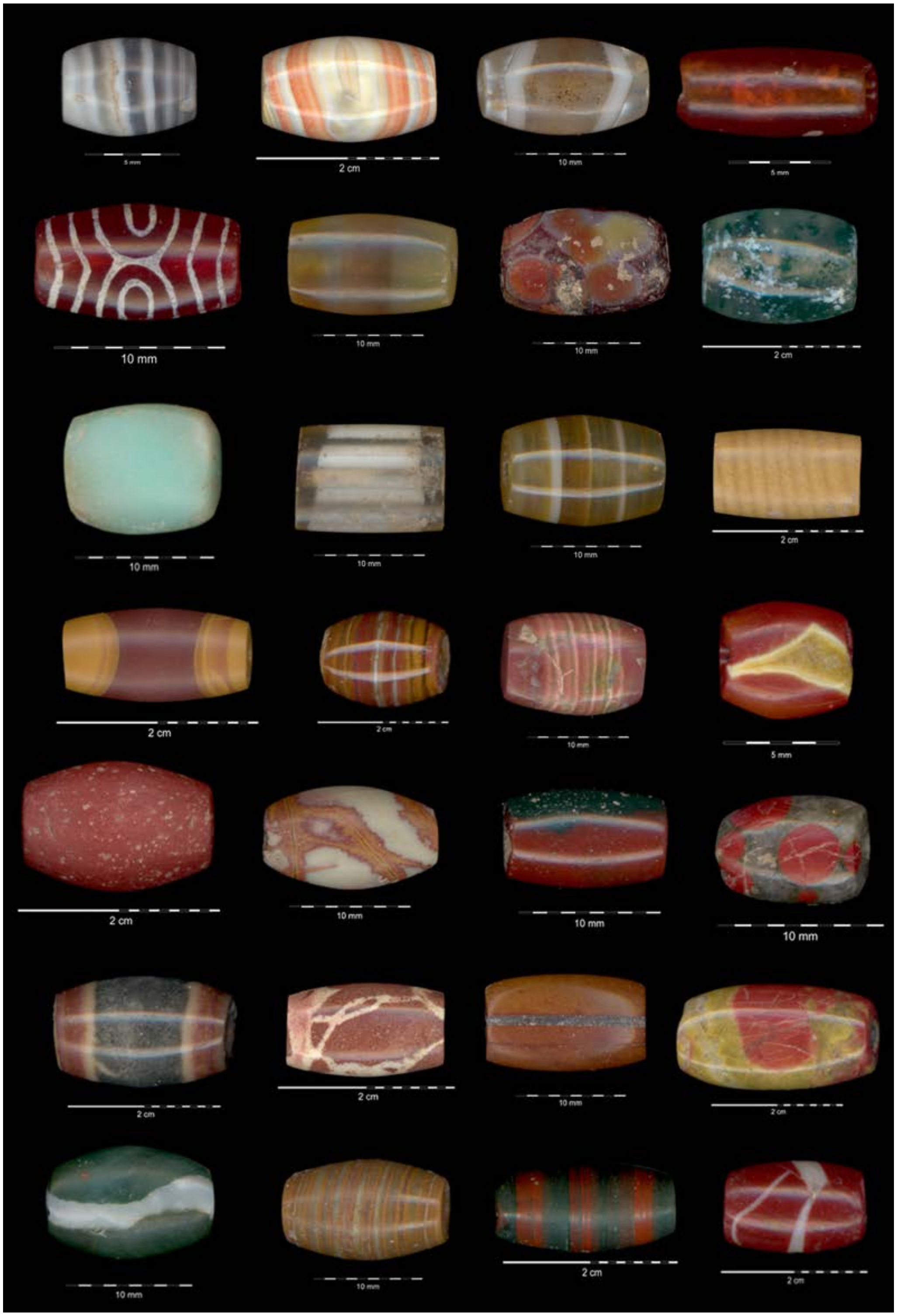


Figure 11.3: A selection of microcrystalline silicate (agate and jasper) beads

Of the roughly 1800 bead artifacts recorded, over 1100 fell into one of these material categories. All of the agate and jasper sub-varieties listed above occur in Gujarat, many within the Kachchh region itself. In order to determine which sources beadmakers at Dholavira used, INAA was conducted at the University of Wisconsin-Madison on a set of carnelian artifacts (see below).

11.1.5.2 Quartzite, conglomerate, sandstone, and siltstone

Nearly 90 beads in the assemblage were made from siliciclastic sedimentary rocks – quartzite, sandstone, conglomerate and siltstone (Figure 11.4 – A to D). Each of these materials is available in the Kachchh region.

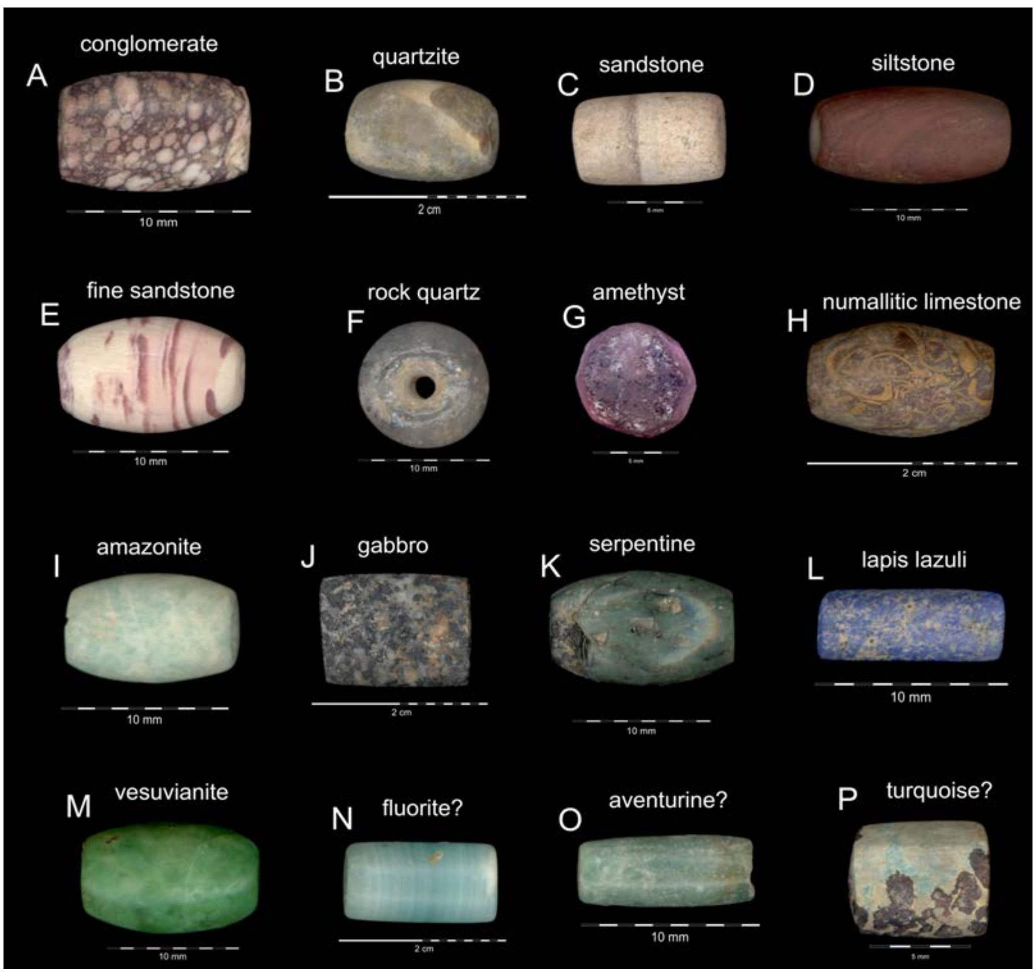


Figure 11.4: Other bead types

XRD analysis performed at the University of Wisconsin-Madison (see below) revealed that a fine-grained white and red-banded bead material (Figure 109 E) that was originally believed to be an indurated clay was actually composed of silt-sized grains of quartz.

11.1.5.3 Quartz crystal and amethyst

Twenty-three beads made from clear quartz crystal (Figure 11.4 F) and two made from the violet-hued quartz crystal known as amethyst (Figure 11.4 G) were recorded. Both quartz varieties occur in geodes within volcanic rocks, such as the western-most outliers of the Deccan Traps that are found in Kachchh and Saurashtra.

11.1.5.4 Limestone

Eighteen limestone beads were recorded in the assemblage (Figure 11.4 H). Multiple varieties of limestone occur across northern Kachchh. The distinctive brown and yellow fossiliferous variety (nummalitic limestone) used to make eight of the beads occurs on Khadir Island within a few kilometers of Dholavira.

11.1.5.5 Amazonite

"Amazonite" is the name for the distinctive green-white variety of the mineral microcline (Figure 11.4 I). It is easily identifiable and distinguishable from other green semi-precious stones by its distinctive planar cleavage. The 87 amazonite bead artifacts recorded in this study most likely derived from the geologic source nearest to Dholavira – the granite pegmatites near the village of Derol in the Palanpur District of northern Gujarat.

11.1.5.6 Basalt and gabbro

Ten beads made from igneous rocks – basalt and gabbro (Figure 11.4 J) – were recorded. Both materials occur in Kachchh.

11.1.5.7 Lapis lazuli

Exactly 125 lapis lazuli beads (Figure 11.4 K) were recorded . It is the mineral lazurite that give this stone its sought after brilliant blue color. Rocks containing other blue-colored minerals, such as azurite and sodalite, can sometimes be misidentified as lapis lazuli. However, only lapis lazuli will contain (usually) minute inclusions of pyrite.

Examination of the Dholavira beads with a Dino-Lite Digital Microscope almost invariably revealed the presence of pyrite inclusions. Moreover, subsequent XRD analyses conducted at the University of Wisconsin-Madison (see below) positively confirmed that the blue phases in these artifacts was indeed the mineral lazurite.

The Dholavira lapis lazuli beads were almost certainly derived from the nearest undisputed geologic source of that stone – the Sar-i-Sang deposits in Badakhshan Province, northern Afghanistan.

11.1.5.8 Serpentine

Around a dozen green-colored beads thought to be composed of a serpentine mineral (Figure 11.4 L), such as antigorite or lizardite, were recorded. Most exhibited a "greasy" texture, splintery fractures and had specific gravities of ≈ 2.53, which slightly too low to be quartz but consistent with serpentine. Minerals of this variety occur in metamorphosed ultramafic rocks. Source regions to which beadmakers at Dholavira might have had access include southern Balochistan, southern Rajasthan and Oman.

Over black 30 beads with a distinctive truncated conical shape were recorded (Figure 11.5). Examination with the Dino-Lite Digital Microscope revealed the presence of translucent dark green crystals within the black matrix. Preliminary XRD analyses at the University of Wisconsin-Madison (see below) indicated that these artifacts are, in part, composed of clinochrysotile, which is a form of asbestos also in the serpentine mineral group. The raw material used to

make the beads probably came from serpentinite formations in either southern Balochistan or Oman.



Figure 11.5: Clinochrysotile beads

11.1.16 Vesuvianite-Grossular Garnet

Twelve semi-translucent green beads were found to have specific gravities ranging from 3.17 to 3.48. This is far too dense for either serpentine or green quartz but within the range of vesuvianite-grossular garnet (Figure 109 M), a hard "jade-like" material that has been positively identified at both Harappa and Mohenjo-Daro.[1]

Beadmakers at those sites were shown to be importing this stone from sources in northern Balochistan and NWFP regions. Unlike at Harappa and Mohenjo-Daro, no vesuvianite-grossular garnet was found in Dholavira's raw material assemblage, which suggests that these beads were brought to the site already finished.

[1] Vidale, M. and P. Bianchetti (1999). "Identification of Grossular (Garnet) as a Possible Item of Long-Distance Trade from the Indus Valley to Mesopotamia in the Third Millennium BC." Ancient Sindh **5**: 39-43.

11.1.5.9 Unfired steatite

Ten unheated (unfinished) steatite beads and bead roughouts were recorded. This number is conspicuously low (as is the low number of steatite artifacts in the raw material assemblage) given the tens of thousands of finished steatite beads recovered at the site. This likely indicates that, unlike Harappa where there are thousands of unfinished beads and raw steatite fragments, Dholavira was not a major steatite bead manufacturing center and that most finished beads found there are imports from other parts of the Indus realm.

The unfinished beads/roughouts exhibited the same macroscopic variability as the unaltered portions of the steatite seals examined (discussed above). INAA studies were conducted at the University of Wisconsin-Madison in order to identify the geologic sources of the raw steatite (see below).

11.1.6 Tentatively identified materials

11.1.6.1 Fluorite

Five delicately banded aqua-green beads (Figure 11.4 N) were tentatively identified at being composed fluorite – a mineral that has been positively identified in beads and raw material at Harappa. One of the largest deposits of this mineral in India occurs at Amba Dongar in southeastern Gujarat.

11.1.6.2 Aventurine quartz/Fuchsite

Five pale green beads (Figure 11.4 O) were tentatively identified as aventurine quartz due to the presence of micaceous inclusions that may be the mineral fuchsite (green muscovite). A cup made from this material was recovered at Mohenjo-Daro. The nearest occurrences of green aventurine are found in central Rajasthan.

11.1.6.3 Turquoise

Five green-hued bead artifacts with brownish patches were recorded that are very likely turquoise (Figure 11.4 P). There are no confirmed sources of this stone in South Asia. The closest known occurrences are located in Tibet, Iran and Central Asia.

11.1.6.4 Pendants/gamesmen



Figure 11.6: A selection of pendants/gamesmen

The 235 small objects recorded in this artifact category have been called by researchers both pendants and gamesmen (Figure 11.6). The majority (n = 143) are composed of igneous rocks –basalt and gabbro. Notable within this subgroup there are some examples with an exquisite fine-grained black and yellow texture that have only encountered at Dholavira. Forty-two examples recorded were composed of siliciclastic sedimentary rocks (quartzite, sandstone, siltstone), 16 of limestone (micritic and nummalitic), 11 of agate or jasper and 1 of calcite. All of the materials mentioned thus far are available in the Kachchh region. Craftsmen at Dholavira would have had to import material from much more distant sources (to eastern Gujarat or beyond to Rajasthan, Balochistan or Oman) in order to create pendants or gamesmen from serpentine (n = 12) or steatite (n = 10).

11.1.6.5 "Ernestite" drills

Among the most important artifacts from Dholavira are tiny drills made from a variety of stones. These drills were used to perforate many different types of objects, but of particular importance are drills made to perforate other hard stones. The study of the Dholavira drills is still ongoing, but detailed recording has been undertaken the approach developed by J. M. Kenoyer at the site of Harappa (with some modifications to address the varieties of drills found at Dholavira).

A preliminary analysis of the drills is based on the recording of 1221 stone drill bits or drill bit roughouts carried out by V. N. Prabhakar and R. W. Law in consultation with J. M. Kenoyer. Eight of the finished were made from tan-gray chert that likely came from the Rohri Hills of Sindh. Two drill like objects, that may not actually be drill bits, were composed of vesuvianite-grossular garnet, a stone that is most probably from a source in west or northwest Pakistan.



Figure 11.7: A selection of "Ernestite" drill bits

The remaining 1211 were fashioned out of the material that Kenoyer and Vidale[2] have dubbed "Ernestite" (Figure 11.7) in honor of Ernest Mackay – the researcher who first described it.[3]

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2 Kenoyer, J. M. and M. Vidale (1992). A New Look at Stone Drills of the Indus Valley Tradition. Materials Issues in Art and Archaeology, III. P. Vandiver, J. R. Druzik, G. S. Wheeler and I. Freestone. Pittsburgh, Materials Research Society: 495-518.

XRD and electron microprobe analyses have been conducted on samples from Harappa, first by Kenoyer and Vidale[4] and later by Law[5] indicated that the "Ernestite" was a mullite-rich rock with phases of quartz or cristobolite, iron-oxide and titanium-oxide. XRD done on "Ernestite" raw material samples from Dholavira (see below) are thus far consistent with these earlier analyses.

However, the assemblage of drill bit artifacts at Dholavira is significantly larger than that from Harappa (only 75 in total have been recovered at Harappa) and exhibits a much wider range of macroscopic variability. Given these facts and that the geology of northern Gujarat is generally suitable for the occurrence of this type of stone, Law feels that the source of "Ernestite" may be located somewhere in Kachchh, perhaps in the vicinity of Dholavira itself.

11.1.6.6 Lithics



Figure 11.8: Tan-gray chert lithics

With the exception of drill bits, lithics (chipped stone tools) were not studied in detail or recorded. However, with the assistance of

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[3] Mackay, E. J. H. (1937). "Bead Making in Ancient Sind." Journal of the American Oriental Society **57**: 1-15.

[4] Kenoyer and Vidale, op. cit.

[5] Law, R. W. (2008). Inter-Regional Interaction and Urbanism in the Ancient Indus Valley: A Geologic Provenance Study of Harappa's Rock and Mineral Assemblage. PhD Thesis. Department of Anthropology, University of Wisconsin-Madison.

Sangita Chakraborty, a cursory inspection of Dholavira's extensive lithic assemblage was conducted in order to assess the general patterns of raw material use and to look for the presence if any unusual materials. We observed that two types of microcrystalline silicates were almost exclusively used to a roughly equal degree: high-quality tan-gray chert (Figure 11.8) and milky white chalcedony (Figure 11.9).

Most of the tan-gray chert probably came from the Rohri Hills of Sindh while chalcedony is available at numerous locations across Kachchh and elsewhere in Gujarat. One important difference is the scarcity of tan-gray chert cores as compared to chalcedony cores. This might indicate that tan-gray chert was brought to Dholavira mostly in the form of long blades rather than bulk raw material.

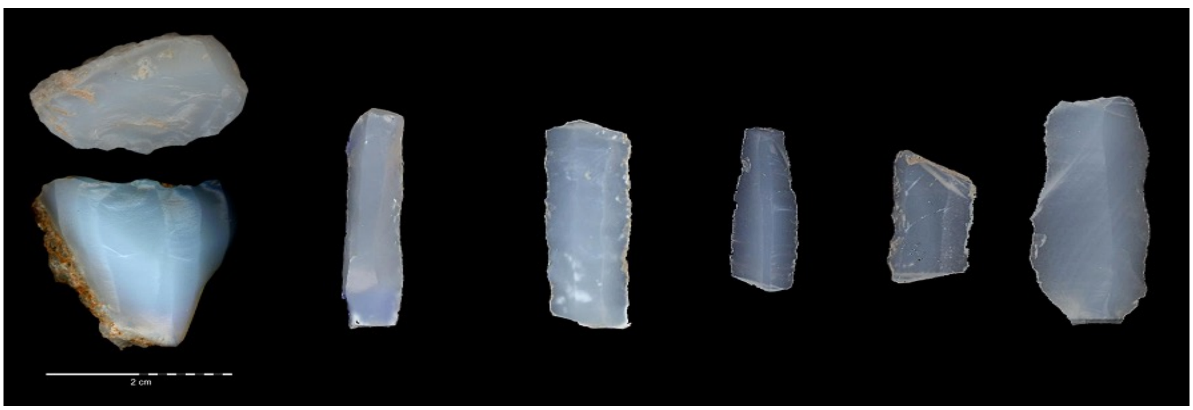


Figure 11.9: Chalcedony lithics

11.1.7 Metals

All lead and silver objects in Dholavira's assemblage of metal artifacts were recorded and non-destructively sampled with an EDTA solution for Pb isotope analysis in the United States (see below). Seventy-one gold beads were scanned and weighed on a precision scale. Copper artifacts have not yet been studied.



Figure 11.10: Lead artifacts

11.1.7.1 Lead artifacts

Forty lead objects were recorded (Figure 11.10). Four or five of them (all recovered from surface or near surface contexts) appear to be lead shot from the modern era. Among the nine unmodified lead minerals recorded are examples of galena (lead sulfide), cerussite (lead carbonate) and massicot (lead oxide). The remaining artifacts are all lead metal and include rods, rings, sheets, ingots, bars and nondescript melted lumps.

11.1.7.2 Silver artifacts

Of the 15 silver artifacts recorded (Figure 11.11), just over half were beads. The remaining items included coils and sheet fragments. Corroded fragments of a silver wire were found inside a vesuvianite-grossular bead. A piece of this wire was examined at the University of Wisconsin-Madison using EMPA and found to be 94% pure silver (see below).



Figure 11.11: A selection of silver artifacts

11.1.8 Vessels

Most of the 45 stone vessel fragments recorded are composed of materials available in Kachchh such as basalt and limestone (Figure 11.12 A). There are, however, a handful of interesting examples that were undoubtedly derived from sources beyond Gujarat. Two vessel fragments composed of chlorite (confirmed by XRD – see below) have parallels in the Oman/Persian Gulf region (Figure 11.12 B & C). Five alabaster (Figure 11.12 D) vessel fragments were made from massive gypsum that likely originated in northern Balochistan, NWFP or Punjab. Finally, a fragment of an onyx marble (aragonite) vessel probably has its origins in the western Balochistan/southern Afghanistan region (Figure 11.12 E).

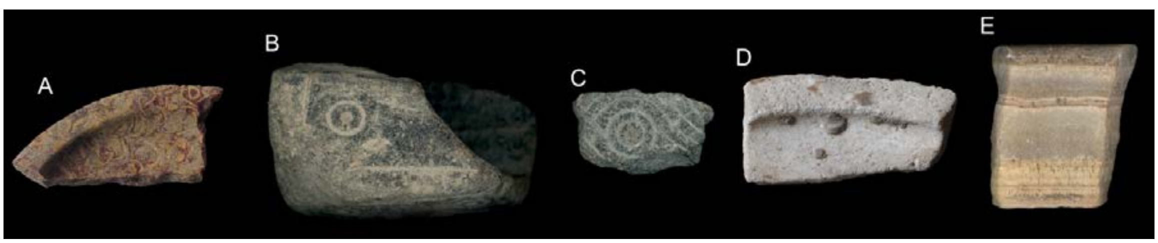


Figure 11.12: A selection of stone vessel fragments

11.1.9 Large stone objects

With the assistance of Nayan Chakraborty, 84 large-sized stone artifacts (querns, mortars, bead grindingstones, pillar fragments and bases, gaming boards and miscellaneous items) were removed from the Dholavira section's storeroom, carefully cleaned and recorded (Figure 11.13). Nearly all were composed of sandstone or limestone (Figure 119) from sources in Kachchh or northern Saurashtra. A few saddle querns appeared to be made from a tough variety of sandstone-quartzite that has its closest parallels in western Sindh.

11.1.10 Miscellaneous items

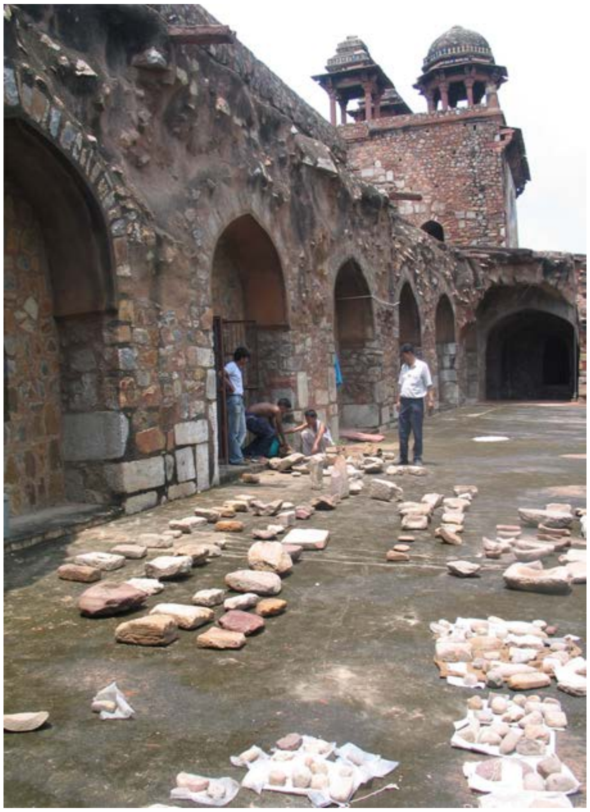


Figure 11.13: Removing the large stone artifacts from the Dholavira storeroom for cleaning and recording.



Figure 11.14: Grooved bead-grinders made from sandstone available in the Kachchh/northern Saurashtra region

There are a wide range of miscellaneous items in Dholavira's stone artifact assemblage such as toy wheels, whorls, rings, discs and grooved objects of unknown function that appear to be composed of locally available sandstone or limestone (Figure 11.15 A-D). Other items, like hand-held bead grinders, drill shapers and flat square and rectangular objects that may be skin rubbers, are made from a tough, coarse-grain, light-colored sandstone (Figure 11.16 A-C), which that might also be local or could come from the Dhrangdhra area of northern Saurashtra (this remains to be confirmed). Whetstones (Figure 11.16 D), burnishers and several other small items are made from gray, brown, red and green siltstones that may be locally available (this also remains to be confirmed).

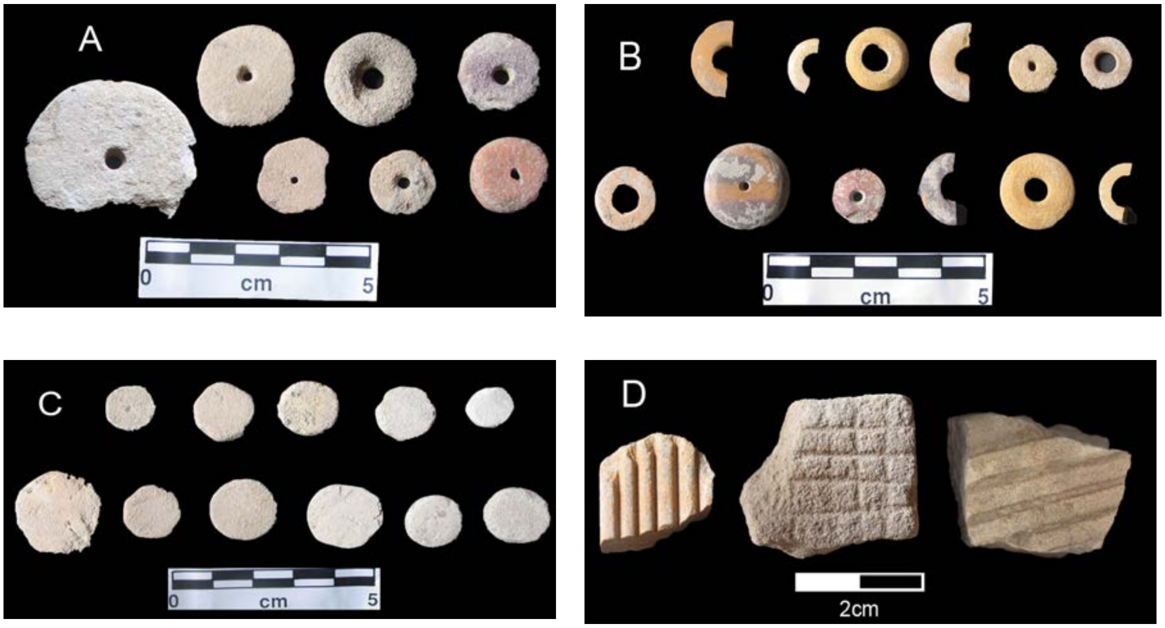


Figure 11.15: Stone A. wheels, B. whorls and rings, C. discs, and D. grooved objects.

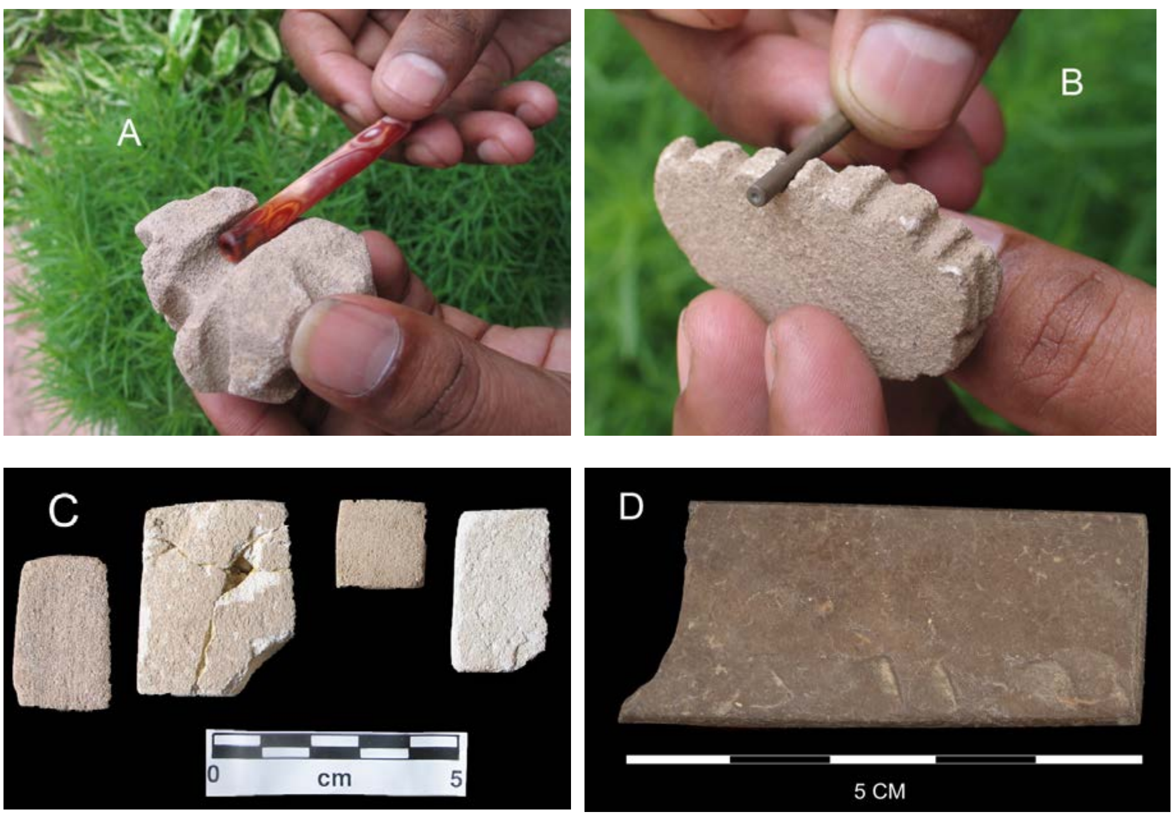


Figure 11.16: A. Hand-held bead grinder, B. hand-held drill grinder, C. skin-rubbers, and D. a typical whetstone.



Figure 11.17: Anhydrite character elements from the Dholavira signboard

Numerous nodules of the iron oxide mineral goethite were recorded (Figure 11.18). Most showed evidence of working on one or more sides, which probably indicates they were being powdered for pigment. Goethite nodules occur in lateritic rocks in the vicinity of Dholavira.

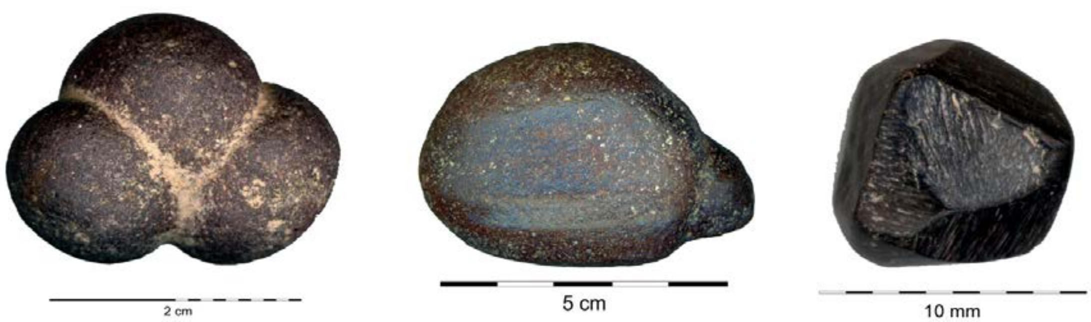


Figure 11.18: Raw and shaped goethite nodules

A number of fossils specimens were recorded (Figure 11.19). These occur in and likely came from the Jurassic sedimentary rocks around Dholavira.

11.1.11 Raw materials

Dozens of bags and trays containing tens of thousands of unregistered raw material “samples” from Dholavira are stored in the section. Three to four weeks were spent just going through these artifacts looking for patterns of usage and documenting important and unique materials. Ultimately, over 1700 artifacts

were recorded. More than 200 registered raw material samples were also examined and recorded. The large majority (perhaps 90% or more) of Dholavira's raw material assemblage is comprised of microcrystalline silicates (Figure 11.20).

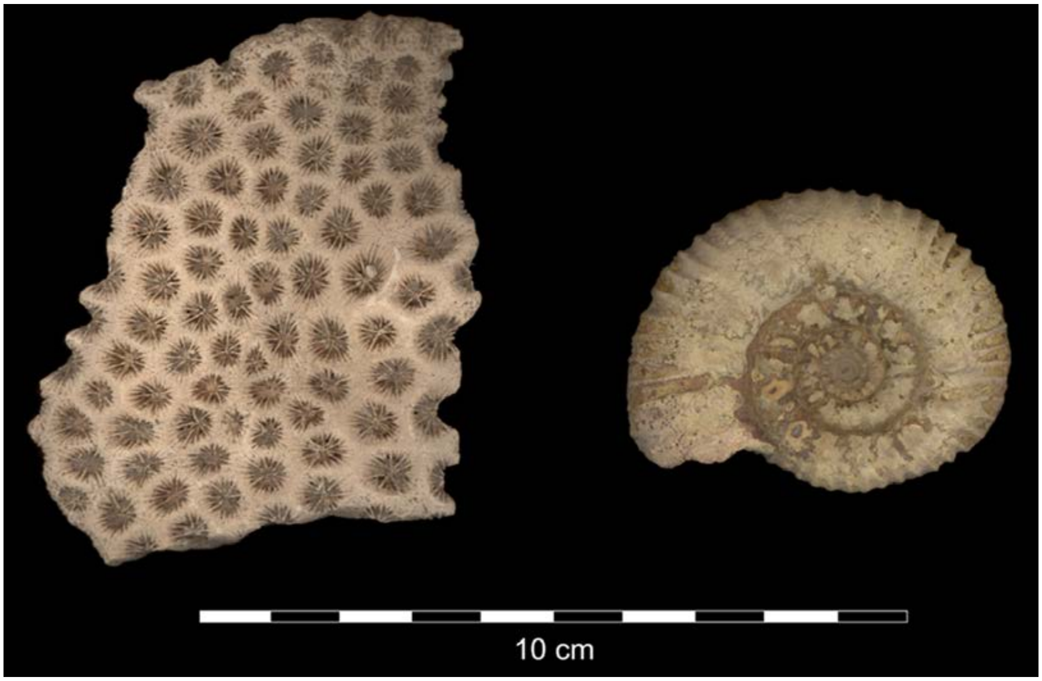


Figure 11.19: Fossils recovered during the Dholavira excavations

All of the agate and jasper varieties discussed in the bead section above were present in forms ranging from tiny flakes to large blocks and unmodified nodules. Other raw materials (Figure 11.21) present in relative abundance are amazonite, basalt, limestone, siltstone, quartz crystal, and amethyst. Examples of raw lapis lazuli, serpentine and "Ernestite" were also found. However, surprisingly little raw steatite was encountered given the large number of finished steatite beads in the collection.

No fragments of vesuvianite-grossular garnet, turquoise, fuchsite or fluorite were found but this was not surprising given the very low numbers of finished artifacts in those materials. The few examples of minerals that could not be identified were eventually brought to University of Wisconsin for XRD analysis (see below).

11.1.12 Studies at the University of Wisconsin-Madison



Figure 11.20: A small selection of microcrystalline silicate raw material from Dholavira



Figure 11.21: A small selection of other types of raw material fragments

Near the end of the research period at Purana Qila, a formal request was made to transport a set of artifact fragments and raw material samples from the Dholavira section to the University of Wisconsin for further, more detailed identification, characterization and provenance analyses. Studies began immediately, with V.N. Prabhakar assisting Dr. Randall Law in the initial sample preparations and analyses. Work has continued steadily for the past year and a great deal of new data has been generated.

11.1.12.1 X-ray Diffraction (XRD) analysis

X-ray diffraction (XRD) analysis is a method that enables one to determine the identity of crystalline substances. To date, over two dozen artifact fragments and raw materials from Dholavira have been analyzed at the S.W. Bailey Memorial XRD Laboratory in the Department of Geoscience, University of Wisconsin-Madison.

Two instruments were used: a Scintag PADV X-ray diffractometer and, beginning in September of 2009, a state-of-the-art Rigaku Rapid II XRD. With the former instrument, tiny amounts of sample had to be powdered prior to analysis. With the latter instrument, points on a sample down to 20 nanometers in size can be nondestructively analyzed in situ.

XRD was conducted on seal fragments and pieces of white material thought to be seal fragments. Analyses of the surface layers of partially fired fragments (raw steatite is evident just below the seals' surfaces) indicated a composition of primarily talc with minor phases of enstatite (talc will convert to enstatite above 900°C).

XRD of fully fired fragments (which are totally white) showed they were composted of enstatite and cristobolite (a polymorph of quartz and a by-product of the high-temperature heating of steatite).



Figure 11.22: The fragment (indicated with red arrow) from seal 21896 selected for XRD analysis.

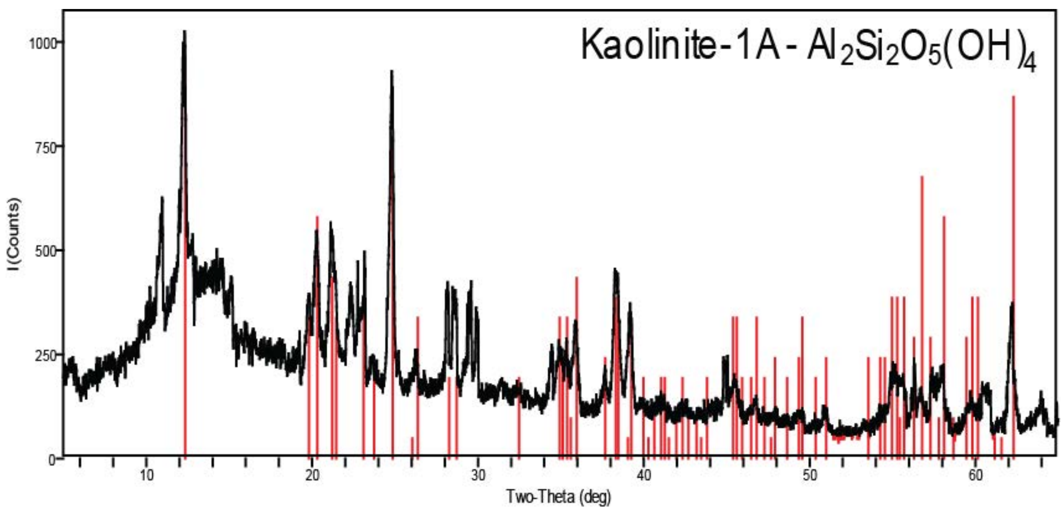


Figure 11.23: XRD spectra indicating that seal 21896 is primarily composed of the mineral kaolinite.

Analysis of fragments (Figure 11.22) of the light-weight seal material with a grayish to off-white appearance and minute dark-colored inclusions (discussed in the seal section above) indicated they were mainly composed of kaolinite with minor amounts of an amphibole mineral (the dark inclusions). A white fragment thought to be from a steatite seal was found to be hydroxylapatite, which indicates it was actually ivory.

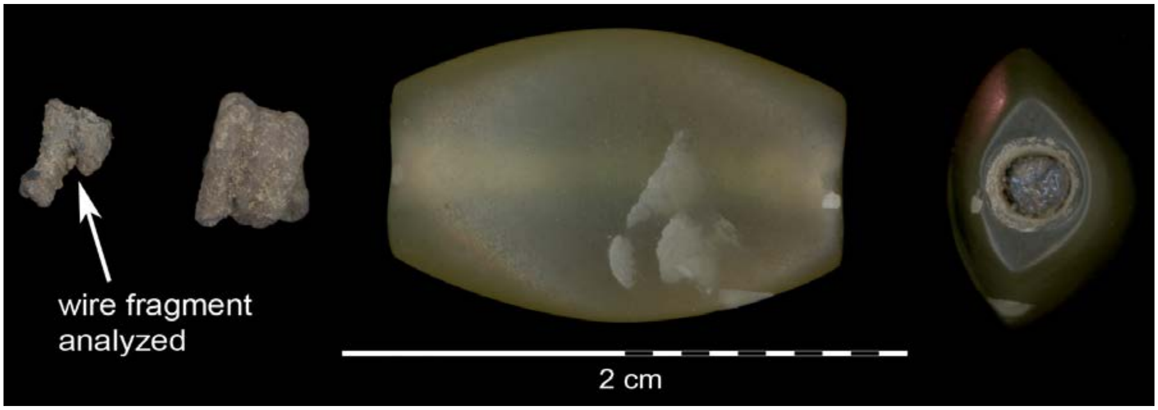
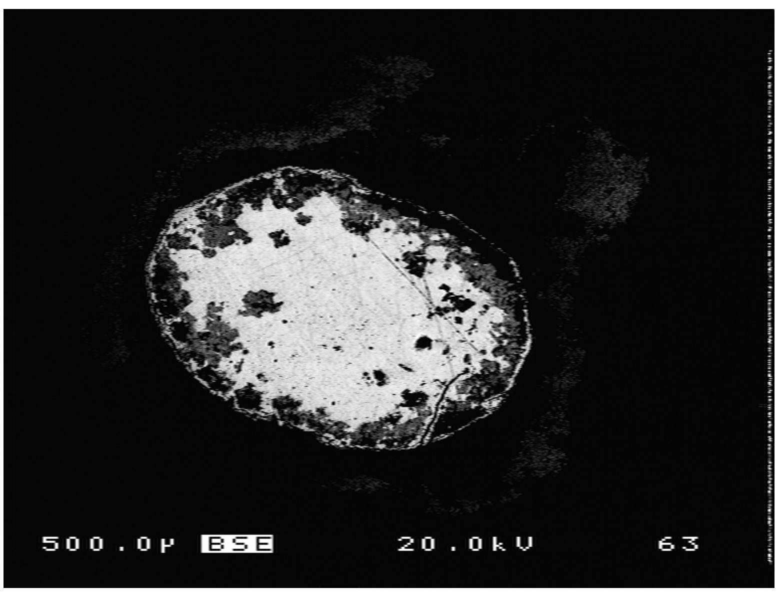


Figure 11.24: Vesuvianite bead containing corroded remnants of a silver wire

Analysis of raw materials, bead fragments and special samples is ongoing. Thus far, XRD of "Ernestite" samples indicated that they were primarily composed of mullite with secondary phases of cristobolite, iron-oxide and titanium-oxide. Fragments of a red stone were found to be cuprite – a copper oxide mineral. Several raw steatite samples contained dolomite in addition to talc, which is indicative of their origin in sedimentary rocks that than in the ophiolite sequences of regions like Balochistan and Oman.



Element	Average **%**
Ag	94.05
Cu	3.65
Pb	1.85
Au	0.45
Total	100.00

Figure 11.25: Back-scatter electro image of wire section and analysis of 15 points

The detection of lazurite in gray-blue rock fragments confirmed the presence of lapis lazuli at Dholavira. Clinochrysotile – a serpentine mineral and form of asbestos –was detected in black conical truncated beads that seem to be

exclusive to Dholavira. Fragments of black vessels that appeared to have parallels at sites in the Persian Gulf region were confirmed to be clinochlore or chlorite. Analysis of a tiny fragment from the North Gate signboard revealed that it was composed of anhydrite, which suggests the sign elements were probably composed of heated gypsum. Work on this problem continues.

11.1.12.2 Electron microprobe analysis (EMPA)

Electron microprobe analysis (EMPA) is a method with which to acquire both qualitative and quantitative compositional data on solid materials as well as a powerful micro-imaging tool. Three artifacts from Dholavira were analyzed on the Cameca SX50/51 electron microprobe at the Eugene Cameron Electron Microprobe Lab in the Department of Geoscience, University of Wisconsin-Madison. Fifteen points on tiny fragments of a silver wire that had been preserved in a vesuvianite-grossular bead (Figures 11.24) were quantitatively evaluated using the microprobes's wavelength dispersive spectrometer (WDS). When the data were averaged it was found the wire was composed of 94.05% silver, 3.65% copper, 1.85% lead and 0.45% gold.

A fragment of lead sheet was qualitatively evaluated with the electron microprobes's energy dispersive spectrometer (EDS) and found to be approximately 85% lead metal. A tiny fragment from a steatite seal (DHR 16863) was briefly imaged with the electron microprobe's back-scatter electron imager. Although it is unclear if the white surface of the seal had been glazed or treated with an alkali, a distinct surface layer is visible in the image. A bright phase that may be preserved remnants of the glaze or alkali was also visible in cracks within the seal body. More detailed characterization of this seal fragment is currently taking place. EDS scans were made of a fragment of a seal (DHR 21896) made from the light-weight material with a grayish to off-white appearance and minute dark-colored inclusions (discussed in the seal section above). The results supported XRD determinations that identified the material's matrix as kaolinite and suggested that the dark amphibole inclusions were hornblende.

11.1.12.3 Variable pressure scanning electron microscopy (VP-SEM)

The variable pressure scanning electron microscope (VP-SEM) is a wonderful tool for artifact analysis. With it is possible to micro-image samples without having to first coat them with a current conducting material such as carbon or gold, as is necessary with conventional scanning electron microscopy (SEM). Moreover, the Hitachi S-3400N VP-SEM at the Eugene Cameron Electron Microprobe Lab in the Department of Geoscience, University of Wisconsin-Madison is equipped with a Thermo Electron EDS and so it is possible to do qualitative evaluations of the composition of the samples being examined. To date, four artifacts from Dholavira have been studied using this instrument.

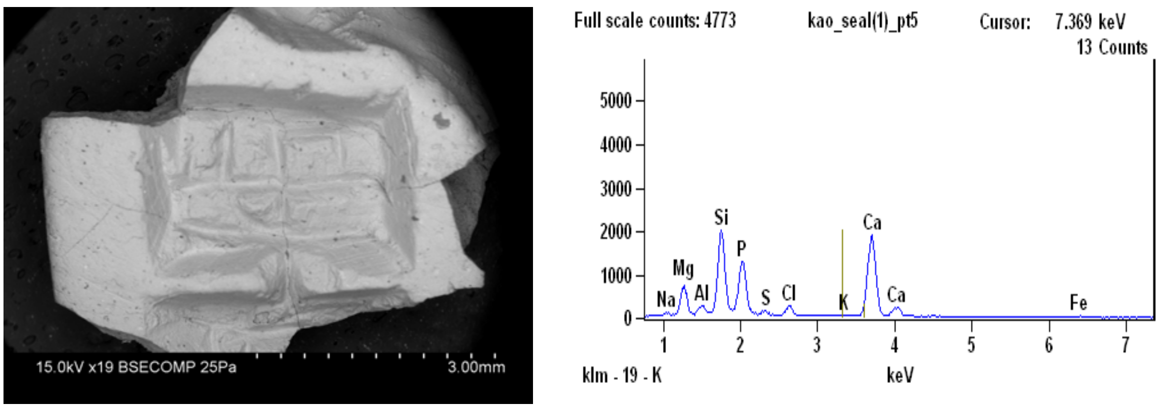


Figure 11.26: VP-SEM image (left) and EDS spectra (right) of seal fragment 26105

The fragment from Dholavira's North Gate signboard was imaged and evaluated with the VP-SEM. In section, the artifact was found to have a homogenous fine-grained structure with no visible inclusions that might be indicative of any additives or binders. EDS scans were made at several points. R.S. Bisht had informed me of the possibly that the gypsum plaster from which the signboard lettering was made might contain a small amount of bone ash (calcium phosphate). However, no calcium or phosphorus was detected. A trace amount of alumina was detected in some scans, which may indicate that clay, possibly kaolinite was used as a binder. Analysis on this artifact continues. Preliminary VP-SEM analyses were conducted on three seal fragments – DHR 26105, DHR 15133 and DHR 16863. Other than spots rich in calcium phosphate

detected on the surface of DHR 26105 (Figure 11.26), no evidence of surface treatments were identified on any of the seals. More detailed analyses are underway.

11.1.13 Instrumental neutron activation analysis (INAA)

Steatite, agate and chert artifacts from Dholavira were subjected to instrumental neutron activation analysis (INAA). This highly accurate and precise method for quantifying the major, minor and trace element compositions of materials has been used by researchers around the world in efforts to identify the geologic sources of a wide range of archaeological stone. In brief, INAA involves the irradiation (or activation) of elements within materials by exposing them to a neutron flux.

Following varying periods of decay, the gamma ray emissions they produce are detected and counted. After the results are screened of elements that failed to be detected in all samples or had high count-rate standard deviations, the data are evaluated using canonical discriminant analysis (CDA). During CDA, linear combinations of variables called discriminant functions are generated that produce a maximum degree of separation (discrimination) between various defined groups of cases, which in this study are the individual sets of samples that Law has personally collected from different geologic sources in India and Pakistan.

Artifacts are plotted as ungrouped cases and assigned to the group (geologic deposit) whose center (or centroid) in multidimensional space they are nearest. Preparation of the Dholavira samples for INAA took place at the Laboratory for Archaeological Chemistry, Department of Anthropology, University of Wisconsin-Madison. INAA was conducted at the University of Wisconsin's Nuclear Reactor (UWNR) research facility by the team supervised by lab director Robert Agasie.

Twenty-nine steatite samples were submitted for INAA (Figure 11.27). Six were samples taken from sawn blockets and manufacturing debris fragments;

thirteen were from unfinished tablets and seal manufacturing debris fragments; eight were from the exposed surface of broken seals; and two were from unfinished pendants.

Steatite

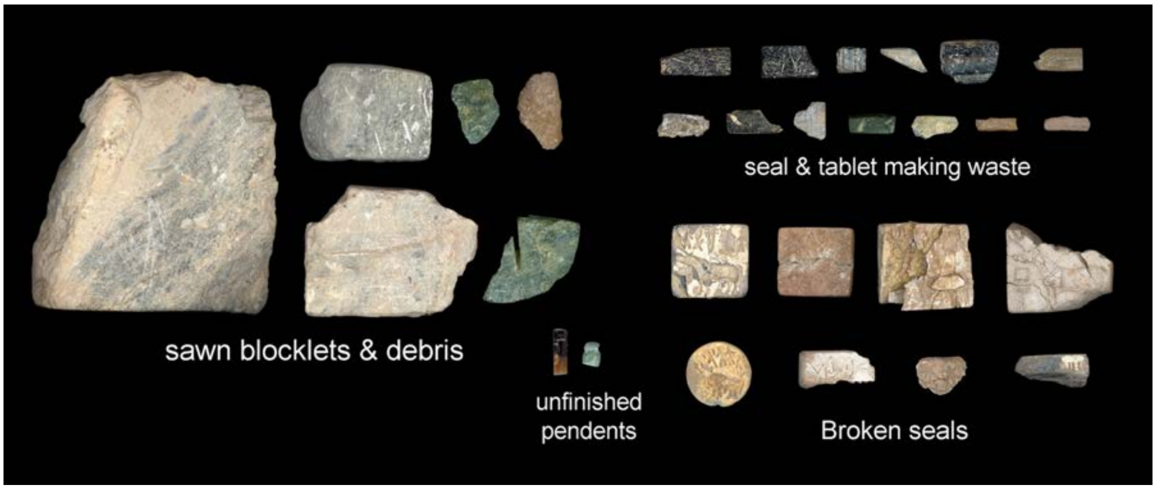


Figure 11.27: Steatite artifacts from Dholavira sampled for this study

Notable among this set of artifacts is a circular "Gulf-style" steatite seal – DHR 3466 (2004) – with Harappan characters and motifs as well a number of grayish schistose debris fragments that bear a strong visual and textural resemblance to raw steatite from deposits in the vicinity of Devni Mori in far northeastern Gujarat.

The INAA results for the 29 Dholavira samples were compared to a database[6] of geologic samples from 37 steatite sources in Pakistan and India (Figures 11.28 and 11.29). Twenty of the 29 appeared to have been made from raw material originating from deposits located in the NWFP, Pakistan and Jammu, India. These are the very same sources from which previous studies[7] have shown residents of Harappa and Mohenjo-Daro acquired the large majority of their raw steatite. Eight of the remaining nine Dholavira samples most closely resemble steatite from the Devni Mori deposits or related geologic occurrences just over the Gujarat state border in southern Rajasthan. This includes all of the

[6] Law, op. cit., Appendix 7.3
[7] Law, op. cit., Chapter 7

gray schistose artifacts that, based on their visual characteristics, were thought to have originated from the Devni Mori area. The circular "Gulf-style" seal also resembles geologic samples from a steatite deposit in Southern Rajasthan. However,

it is highly distinct compositionally from the other eight artifacts that were assigned to the northeastern Gujarat/southern Rajasthan region. CDA will assign an artifact to the deposit it most closely resembles geochemically regardless of whether or not it is the true source of the artifact. It is quite possible that "Gulf-style" seal was made from steatite from a deposit, possibly in the Persian Gulf region, not yet represented in the database.

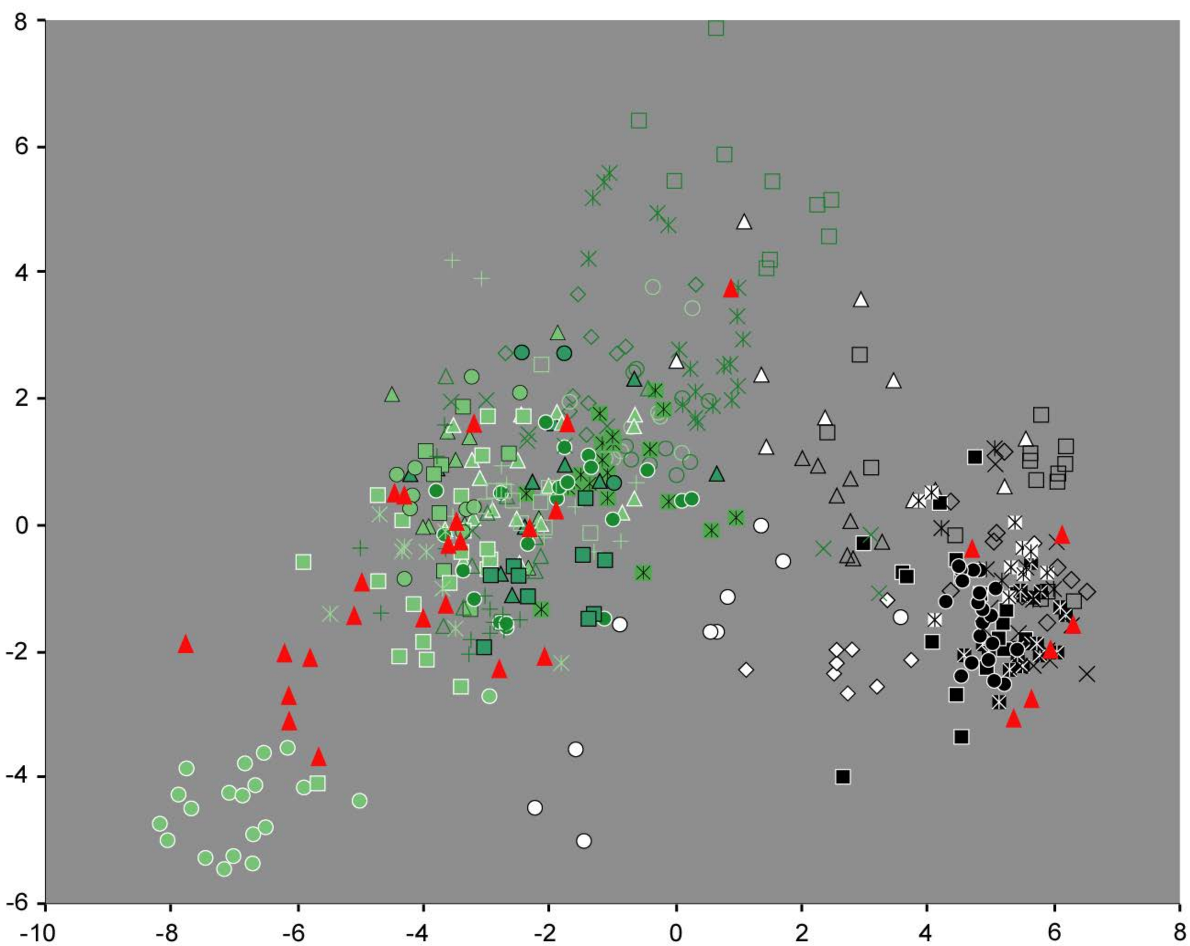


Figure 11.28: CDA comparison of 29 steatite artifacts from Dholavira to 443 geologic samples from 37 steatite sources in India and Pakistan

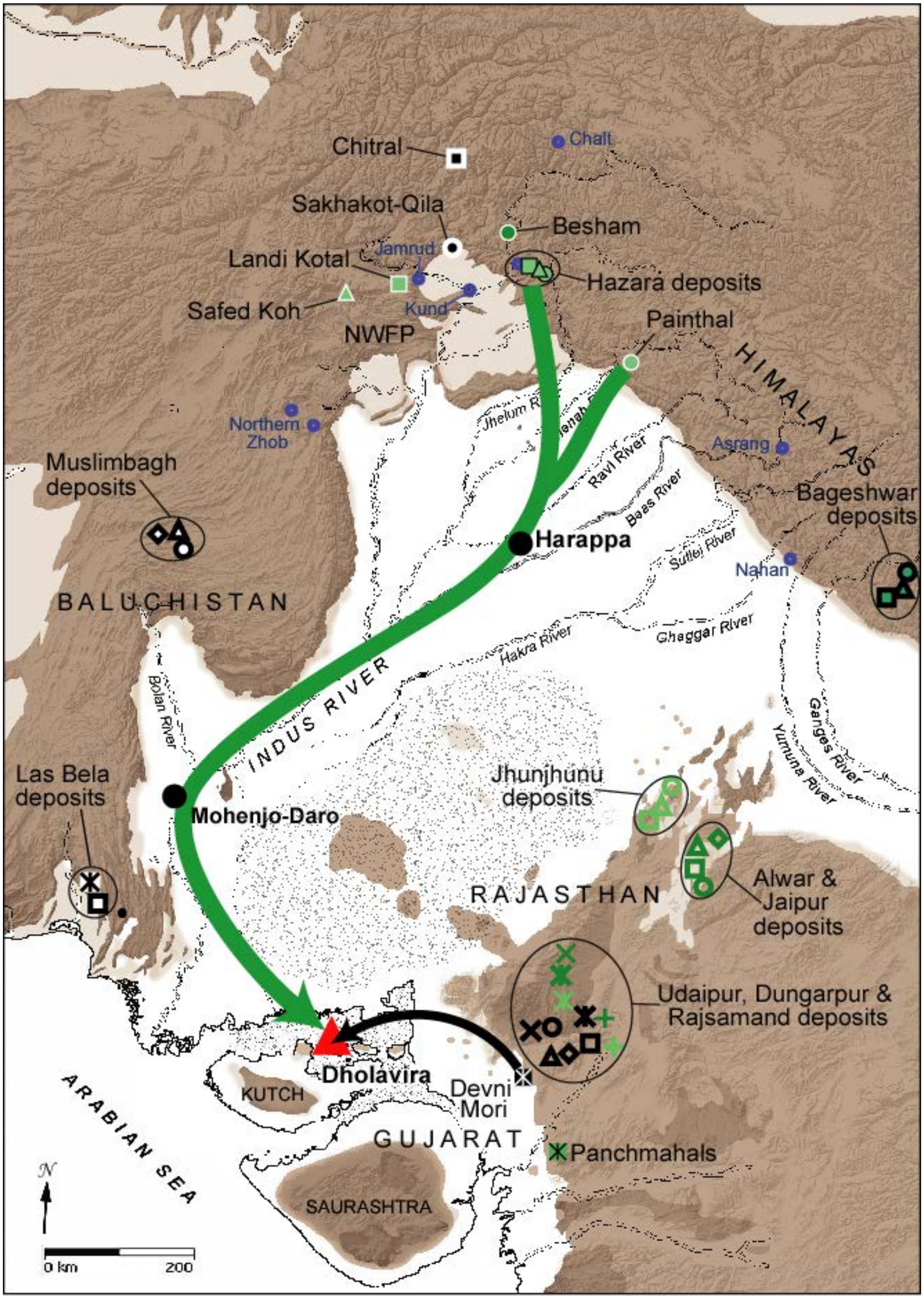


Figure 11.29: Provisional steatite acquisition routes for the site Dholavira

11.1.13.1 Agate

Thirty-one samples of agate from Dholavira were submitted for INAA. Fourteen were pieces of carnelian (red-orange agate) debris while seventeen were fragments of the type of yellow-brown agate that will become red-orange when heat-treated. The artifacts were compared to a database of geologic samples[8] from three agate sources in Gujarat and one in eastern Iran (Figure 11.30). The Gujarati sources include the deposit at Khandek in eastern Kachchh (70 km from Dholavira), the extensive agate beds on Mardak Bet in the Little Rann of Kachchh (105 km from Dholavira), and the famous agate mines of Ratanpur in southern Gujarat (390 km from Dholavira).

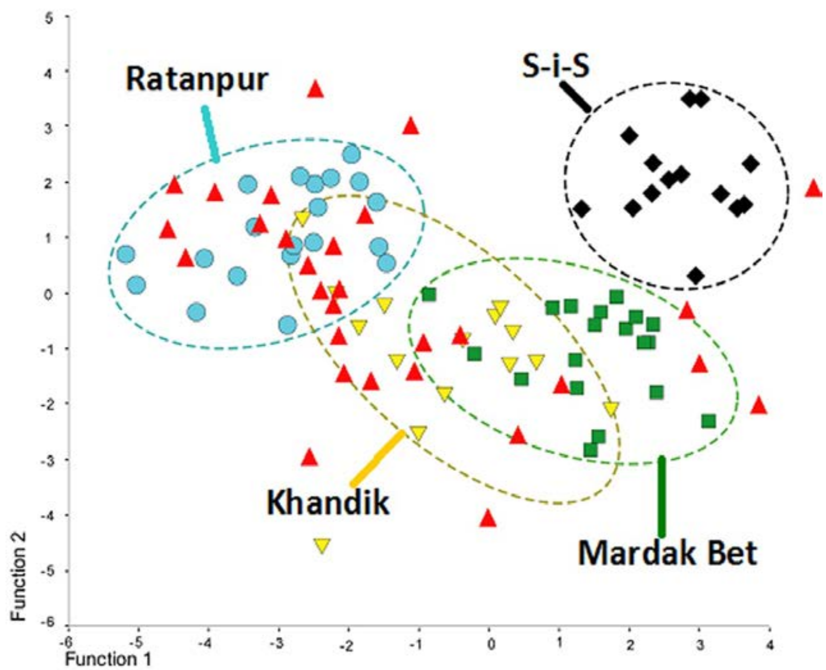


Figure 11.30: CDA comparison of agate artifacts from Dholavira to geologic samples from four sources.

Nearly half (15 of 31) of the samples were predicted to have come from the closest source at Khandek, while six and ten samples respectively came from Mardak Bet and the Ratanpur mines (Figure 11.30). These results indicate that although beadmakers at Dholavira utilized multiple agate-carnelian sources in Gujarat, most of the raw material they acquired came from deposits relatively near the site in the Kachchh region.

[8] ibid., Appendices 8.1 to 8.4

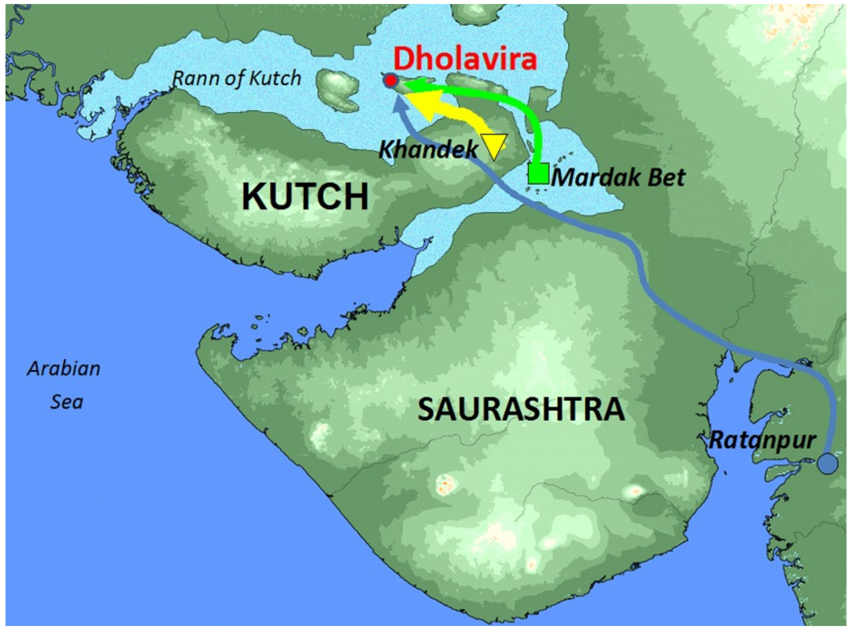


Figure 11.31: Provisional agate acquisition networks for Dholavira

11.1.13.2 Chert

Twenty-five tan-gray chert flakes from Dholavira were submitted for INAA in order to test the assumption that most or all chert artifacts of this description from the derived from the Rohri Hills of Sindh, Pakistan. The samples were selected to be as macroscopically variable as possible. Some examples were visibly indistinguishable from banded chert fragments Law had personally collected in the Rohri Hills while others, although tan or gray, appeared as if they could come from a different sources. The artifacts were compared to a database of geologic samples[9] representing four locations within the Rohri Hills and sources located in the Punjab, NWFP and Balochistan Province, Pakistan (Figure 11.32).

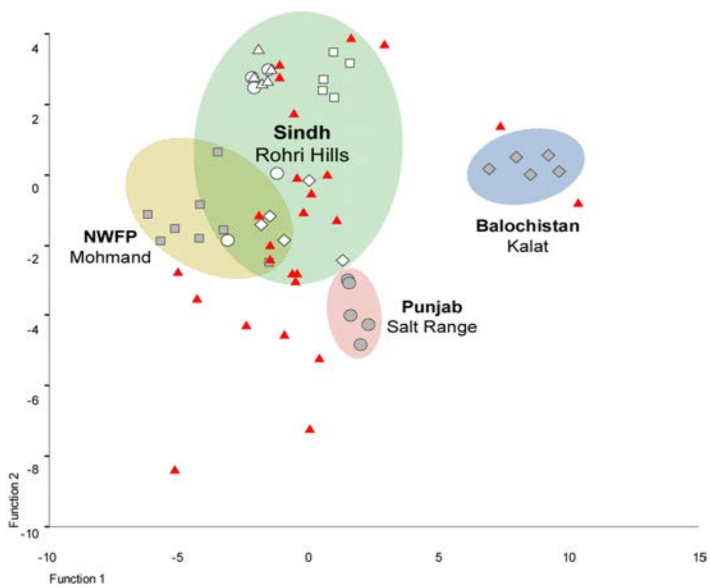
Over half (15 of 25) of the chert artifacts (Figure 11.32) were predicted to derived from one of the Rohri Hills deposits in the database. Two artifacts were most closely related to geologic samples from an occurrence in the Kalat District of southern Balochistan. The remaining eight artifacts, although given a

[9] ibid., Appendices 6.5 and 6.6

predicated group membership by CDA in one of the other groups, did not plot closely with their predicted sources in a bivariate plot of distriminant functions. It may indicate that the actual source of these artifacts is not represented in the database. The true source could be another location in the Rohri Hills that has not yet been sampled or it could be an unsampled tan-gray chert source in a different region, such as Tharro Hill or Kotri in the far southern part of Sindh.

The results suggest (Figure 11.33) that although the majority of tan-gray chert at Dholavira probably indeed comes from the Rohri Hills of Sindh, other sources were probably used as well. One of these other sources appears to be in the Kalat District of Balochistan. The identity of the other sources in unclear but work will continue on this problem.

Figure 11.32:
CDA comparison of tan-gray chert artifacts from Dholavira to geologic samples from four source areas.



11.1.14 Pb isotope analysis using Thermal Ionization Mass Spectrometry (TIMS)

A completely non-destructive method of Pb isotope analysis for lead[10] and silver[11] artifacts was developed at the University of Wisconsin-Madison by

[10] Law, R. W. and J. H. Burton (2006). Non-Destructive* Pb Isotope Analysis of Harappan Galena Fragments Using Ethylenediaminetetraacetic Acid and ICP-MS. (*Practically). Proceedings of the 34th International Symposium on Archaeometry, Zaragoza, 3-7 May 2004. J. Pérez-Arantegui. Zaragoza, Institución Fernando el Católico: 181-185.

[11] Law, R. W. and J. H. Burton (2008). "Non-Destructive Pb Isotope Sampling and Analysis of Archaeological Silver Using EDTA and ICP-MS." American Laboratory News **40**(17): 14-15.

Randall Law and Dr. James H. Burton. All items composed of these metals at Dholavira (40 lead and 15 silver artifacts) were briefly immersed (Figure 11.34) in a solution consisting of ultrapure water and 0.05% dissolved EDTA—a non-toxic hexadentate chelating agent that forms coordinate bonds with lead atoms. This resulted in no alteration whatsoever of the artifacts, which were dried and returned to their place of storage in Purana Qila.

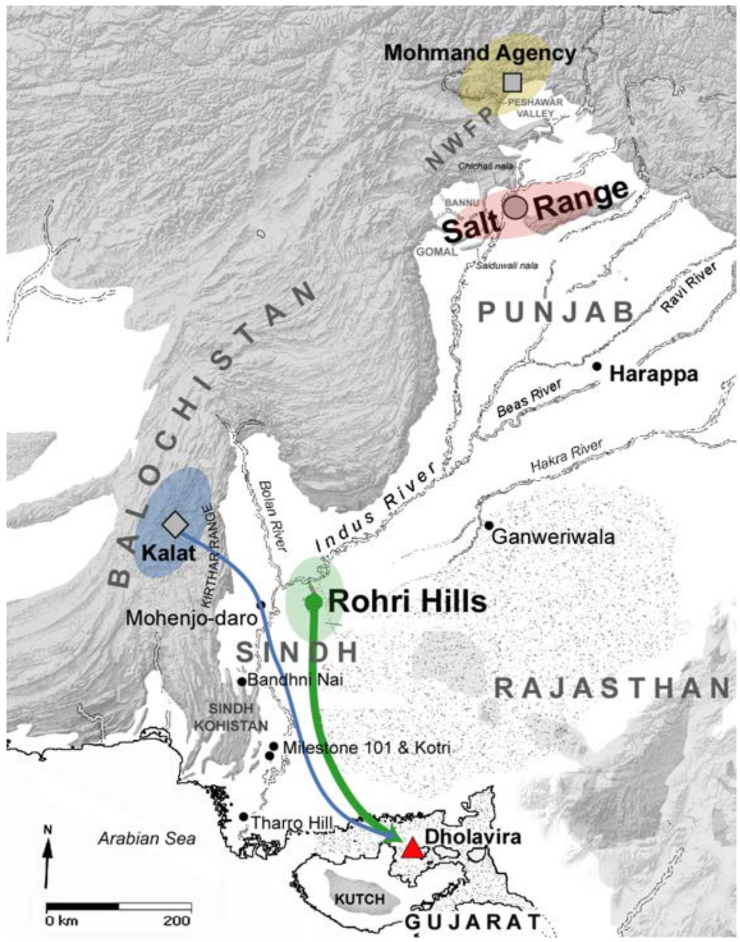


Figure 11.33: Provisional tan-gray chert acquisition networks for Dholavira

The EDTA solutions (Figure 11.35) were returned to the United States for analysis. The element lead has four isotopes (^{208}Pb, ^{207}Pb, ^{206}Pb, and ^{204}Pb) that vary in absolute amounts, depending on the geologic age of the lead deposit and the conditions in which it mineralizes. These isotopes do not undergo physiochemical fractionation when an ore is smelted or when the extracted metal is fashioned into finished objects. Thus, an artifact containing lead from a single

deposit will retain the original isotopic composition of that deposit. Although it is a potential problem that alloyed or recycled metal objects may contain lead derived from multiple sources, Pb isotope data are, nonetheless, extremely useful for archaeological studies attempting artifact-to-ore source correlation.

This includes artifacts composed of silver, which is most commonly obtained through the cupellation (refinement through the oxidation of base metals) of argentiferous (silver-rich) lead ores. Ten of the EDTA sampled artifacts were selected for the first round of Pb isotope analysis. Four of these were unaltered lead minerals (galena) and so, for these four samples at least, the potential problem of source mixing is not an issue. Of the remaining six artifacts, three were corroded lumps of lead metal and three were composed of silver (a bead, a wire fragment and a flattened sheet).



Figure 11.34: Lead and silver artifacts immersed in the non-destructive EDTA sampling solution.

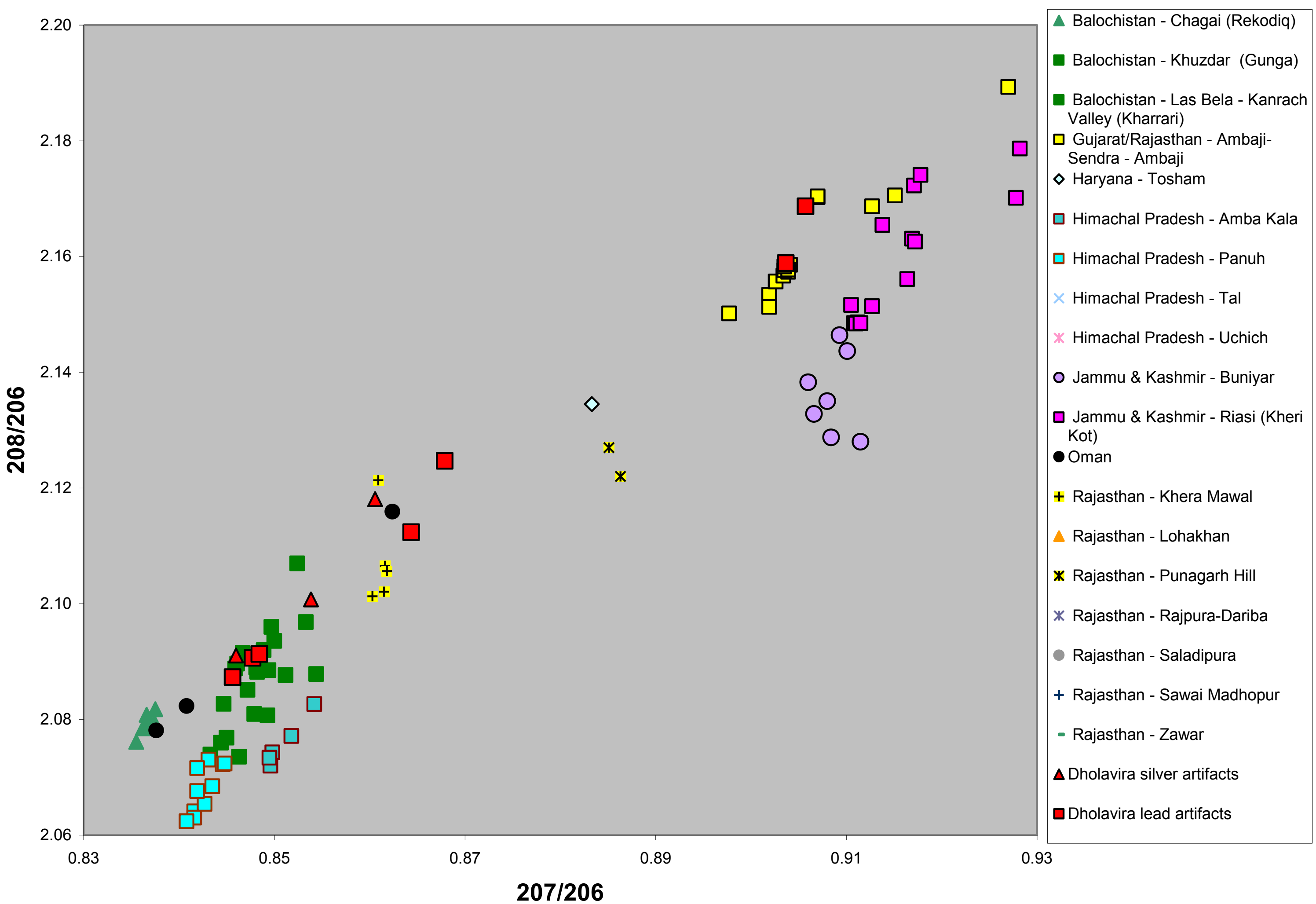


Figure 11.35: Solutions for sampled lead and silver artifacts ready for return to the lab.

Pb isotope analyses were conducted by Dr. Drew Coleman Department of Geological Sciences, University of North Carolina at Chapel Hill. The results were compared to a database[12] of 211 Pb isotope determinations made for 45 individual lead occurrences in India, Pakistan and Oman.

Exactly half of the artifacts analyzed (two galena fragments, a lead lump, the silver bead and silver wire) appear to have come from a source or sources in the southern Balochistan region (Figure 11.36). Two other artifacts (a galena fragment and a lump of lead metal) are isotopically analogous to a deposit in northern Gujarat at Ambaji. The remaining three artifacts (a galena fragment, a lump of lead metal and the silver sheet) are not clearly analogous to any source currently in the database, although they do fall somewhat nearby data points for lead occurrences in both southern Rajasthan and Oman.

[12] Law, op. cit., Appendix 12.1



208/206
207/206
2.20
2.18
2.16
2.14
2.12
2.10
2.08
2.06
0.83
0.85
0.87
0.89
0.91
0.93
Balochistan - Chagai (Rekodiq)
Balochistan - Khuzdar (Gunga)
Balochistan - Las Bela - Kanrach Valley (Kharrari)
Gujarat/Rajasthan - Ambaji-Sendra - Ambaji
Haryana - Tosham
Himachal Pradesh - Amba Kala
Himachal Pradesh - Panuh
Himachal Pradesh - Tal
Himachal Pradesh - Uchich
Jammu & Kashmir - Buniyar
Jammu & Kashmir - Riasi (Kheri Kot)
Oman
Rajasthan - Khera Mawal
Rajasthan - Lohakhan
Rajasthan - Punagarh Hill
Rajasthan - Rajpura-Dariba
Rajasthan - Saladipura
Rajasthan - Sawai Madhopur
Rajasthan - Zawar
Dholavira silver artifacts
Dholavira lead artifacts



Figure 11.37: Harappan lead and silver acquisition/trade networks

The fact that one of these three artifacts is an unadulterated lead ore confirms that there is a lead-silver source somewhere with these isotopic characteristics and that, for the ore definitely and probably for the other two artifacts as well, this is not simply a case of source mixing. Interestingly, numerous lead and/or silver artifacts from Harappa, Mohenjo-Daro and Allahdino also plot in this ambiguous area. The new data produced for these Dholavira artifacts have helped to further our understanding of the acquisition

and trade networks for these metals during the Harappan Period (Figure 11.37).

11.2 A Preliminary Report on the Molluscan shell assemblage from Dholavira

Dr. Arati Deshpande-Mukherjee and
Ms. Anuradha Gupta

The excavations in the 1990's at the Harappan site of Dholavira situated in the Kachchh district of Gujarat have yielded one of the largest shell assemblages to be unearthed so far from an Indian archaeological site.

11.2.1 Aims and Objectives

The broad aims and objectives of the research are outlined as follows

a) To Identifiy the various molluscan species recovered from the site.
b) To study their layer and phase wise frequency distribution
c) To identify the factors responsible for the occurrence of molluscs at Dholavira
d) Identification of their source areas from where they were procured or accidentally introduced.
e) To reconstruct different aspects of shell working at the site during various cultural periods
f) Identification of shell working areas
g) To study the changes in shell use at the site through time
h) A comparison with other major Harappan shell working sites such as Mohenjo-daro, Harappa, Chanhudaro, Lothal, Nageshwar, Bagasra, Kuntasi, Nagwada, is to be made.

More than 2000 shell remains have been examined so far. A detailed analysis of the shell assemblage involving both layer and phase wise distribution, measurements and spatial distribution is currently underway. For the study the entire molluscan assemblage was grouped into the following categories.

1. Isolated complete to broken shells
2. Shell debitage comprising sawn shell fragments of the gastropods *Turbinella pyrum, Chicoreus ramosus* and *Pugilina buchephala*
3. Finished shell objects
4. Unfinished shell objects

The shell analysis involved taxonomic identification of the various molluscan shells to the species level. The shell assemblage was subjected to taphonomic observations such as charring, discoloration, breakage, abrasion, weathering, modification, etc. Both MNI and NISP determination was also carried out. Dimensional measurements were taken wherever necessary. In general the state of preservation of the shell remains is in fairly good condition

11.2.2 The molluscan shells from Dholavira

At Dholavira, empty dead shells of the animals belonging to the Phylum Mollusca, an invertebrate group of organisms have been recovered from all over the site in appreciable numbers. These have been found ranging from complete to broken, fragmented ones. Their shell identification revealed the presence of a variety of molluscan species belonging to both marine as well as freshwater habitat (Table 1). No land snails have been recorded so far.



Fig. 11.38.: *Turbinella pyrum*



Fig. 11.39: *Chicoreus ramosus*

A majority of the molluscs identified are of marine origin of which marine gastropods are maximum in number (16). The most commonly occurring shells

are those of the large marine gastropod *Turbinella pyrum* which externally has a smooth white shell and an internal thick columella having grooves (Fig.11.38). This is represented by complete shells as well as parts such as columella, apex, spire portion and main shell whorl fragments. Most of the shells range in size from 90 to 200mm. Similar shell fragments of another large gastropod *Chicoreus ramosus* are also recorded (Fig. 11.39). Externally the shell is covered with numerous spines whereas internally the columella is devoid of grooves. A few shell fragments such as main shell whorl, columella of *Pugilina buchephala*, a shell smaller in size compared to *T. pyrum* and *C. ramosus* are also identified.



Fig. 11.40: ***Terebralia palustris***



Fig.11.41: ***Telescopium telescopium***



Fig. 11.42: ***Thais carinifera***

Besides these, shells of small gastropod like those of *Thais carinifera, Conus* sp., *Cypraea* sp., *Oliva* sp. *Nerita* sp., *Natica* sp. *Neritina crepidularia, Cerithidae cingulata, Telescopium telescopium and Terebralia palustris* occur alongside of which the latter two are fairly common (Fig. 11.40, 11.41 & 11.42) (Table 1). Besides gastropods a large number of scaphopod shells belonging to D*entalium* sp. occur. Very few marine bivalves are identified most common being the large blood cockle *Anadara* sp. (Fig. 11.43) along with broken shells of venerid clams *Paphia gallus.* Athough two varieties of oysters are recorded *Crassostrea* sp. *and Placuna placenta* their occurrence is very limited. **Freshwater molluscs** are represented by a few shells of the freshwater bivalves

Lamellidens sp. and *Pareyssia* sp. (Fig. 11.44) along with small gastropod shells of *Melania striatella tuberculata.*



Fig. 11.43: *Anadara* sp.



Fig. 11.44: *Pareyssia* sp.

Among all these only certain shells like those of *Turbinella pyrum, Chicoreus ramosus, Pugilina buchephala, Conus sp., Nerita* sp. show signs of human activity.

Table : 1. Molluscan taxa identified at Dholavira

MOLLUSCS	**Bivalves**	**Gastropods**
MARINE	*Anadara sp.* *Meretrix meretrix* *Paphia gallus* *Placuna placenta* Mussel , *Crassostrea* sp.	**Large size** *Turbinella pyrum* *Chicoreus ramosus* *Pugilina buchephala* **Medium size** *Telescopium telescopium, Terebralia palustris, Elllobium aurisjudae Babylonia spirata, Thais carinifera, Conus sp. , Bursa sp. Oliva sp.* **Small size** *Cypraea* sp., *Nerita* sp., *Natica* sp*.* *Neritina crepidularia, Cerithidae cingulata*. **Schaphopoda Dentalium sp.**
FRESHWATER	*Lamellidens* sp. *Pareyssia* sp.	*Melania striatella tuberculata*

The preliminary study has indicated the following:

1. Presence of a rich shell industry where manufacture of various kinds of shell objects was being carried out within the settlement.
2. Besides production for export, shell objects were used by the Dholavira inhabitants in their day to day activities
3. Occurrence of certain molluscan shells which were brought to the settlement due to natural agencies such as wind, inundation, and human related activities

11.2.3 The Shell industry at Dholavira

At Dholavira the presence of a past flourishing Harappan shell industry is strongly indicated by the occurance of a large number of sawn cut shells as well as a variety of finished and unfinished shell objects.

11.2.3.1 The Shell objects

A variety of shell objects have been recorded which comprises bangles, ladles, Inlays, rings, beads, bowls, and miscellaneous objects**.**

Shell bangle fragments are one of the most commonly found objects at Dholavira. More than 2000 fragments were recovered. These vary in width from narrow to broad bangles (Fig. 11.45 & 11.46). Most of them have the characteristic 'V' shaped chevron motif engraved on the surface (Fig. 11.47). Presence of a multiple grooved bangle fragment is observed (Fig. 11.48) . It appears that although most bangles were meant for adults to wear, some were also worn by children and sub adults. These were mainly made using *T.pyrum* shells also other shells like *Pugilina buchephala* and *C. ramosus* could have been used.



Fig. 11.45: bangle with Chevron motif



Fig. 11.46: complete bangle



Fig. 11.47: Broad bangle with incised lines



Fig.11.48: multiple grooved bangle fragment

Shell beads the site has produced one of the largest number of shell beads of various shapes and sizes around 1,130 (Fig. 11.49 & 11.50) Commonly occurring shapes are flat, circular, cylindrical, disc, barrel, tubular, etc.

These were produced using the main shell fragments of *T. pyrum* and *P. buchephala.* Besides these a few perforated shells of *Conus* sp., *Nerita* sp. and *Oliva* sp. occur which could have also been used as beads. Presence of *Dentalium* shells in good numbers (n=382) also indicates a similar use.





Fig. 11.49 & 11.50: Shell beads

Shell ladles a total of 143 were recorded at Dholavira of which 7 are complete ones. Complete ladles range from small to large sized ones the smallest measures 37.76mm in width and 44.18mm in length. The largest recorded was made from *T.pyrum* shell , the handle has 4 incised lines on one side. It measures138.20m in width and has a length of 150.00 mm. The ladles are simple lacking any decorations. While the rest are mostly fragments from the main ladle and its handles. A majority were made using C*hicoreus ramosus* shell but some made from *T.pyrum* shell are also present. It appears fairly large-sized *Chicoreus ramosus* shells were used. (Fig. 11.51 & 11.52)





Fig. 11.51 & 11.52: Shell ladles

Shell bowls: No complete bowls have been found. However small triangular to trapezoidal concave shell fragments from *T.pyrum* and *Pugilina buchephala* are present. Most of them are plain have two rows of incised lines

running parallel to the shell margins on their outer surface (Fig.11.55). The edge of one margin is rounded. As many as 48 fragments have been found. It appears that these trapezoidal fragments were cut from the main shell whorl and then probably glued together to form a bowl having flaring walls. For this use was made of small to medium sized shells in the size of 50-90mm.



Fig. 11.53: Broken Ladle handles



Fig.11.54: A large unfinished broken ladle

One interesting fragment has a Pipal leaf motif on its outer surface (Fig.11.56). Such shell bowls might have served as either items of status or used for specific purposes. Similar ones have been reported from Lothal, Mohenjo-daro, Harappa and Chanhudaro.



Fig. 11.55: Shell bowl fragments



Fig.11.56: Fragment with a Pipal leaf motif

Shell Inlays have been recovered in fairly good numbers and occur in a variety of shapes but are mostly small in size.. These were made from the main shell whorl of *T.pyrum* and *Pugilina buchephala* which was cut into various small flat geometric shapes like triangles, squares, circular, oval, diamond, etc. Some have perforations, Lattice pattern inlays were also produced reflecting the craftsmanship of the Dholavira shellworkers. Similar ones have been reported from Mohenjo-daro and Lothal.



Fig. 11.57: Perforated inlay pieces



Fig. 11.58: Flat inlay with serrated margin





Fig. 11.59 & 11.60: Shell inlays

Shell objects made from the Columella of *T.pyrum or Pugilina buchephala* were also an important aspect of the shell industry at Dholavira. It

appears that all sizes of columellae were preferred. Most of them were obtained during the manufacture of bangles, ladles and were specially retained for further use. Different types of objects were produced. Most common ones are long and short cylindrical cones tapering towards the base of the columella. By trimming and smoothening the grooves the columella is given a rounded appearance. These with a little engraving at the anterior end might have been used as handles (Fig. 11.63). At times the columella was sawn horizontally just below the grooves by which smaller cones were obtained. The exact function of these cones is yet to be learnt.



Fig. 11.61: *T. pyrum* columella



Fig. 11.62: *T. pyrum* columella abraded



Fig. 11.63: Finished columella object



Fig. 11.64: Cones



Fig. 11.65: Hollow tubes



Fig. 11.66. Cylindrical rod

Many of the columellae were made into beads, cylindrical rods, hollow tubes, etc. At Dholavira too, shell rings might have been manufactured using the columella quite sImilar to that reported from Nagwada (Bhan and Gowda 2003) .

Complete shells An interesting finds are two complete *T.pyrum* shells with their internal columella removed. All along their aperture two fine lines have been incised One was found in the Middle town having a height of 126.17mm and the other one having a height of 87.84 mm. A similar shell is reported from Chanhudaro and Harappa. These were probably used in rituals or might have been also used as feeding cups for children.



Fig. 11.67. Complete *T.pyrum* shell with internal columella removed

11.2.4 Shell working technology

In recent years the manufacturing process involved in the production of shell bangles, ladles, rings has been well reconstructed for many of the Harappan sites. Since during shell working very distinct debitage results from which one is able to reconstruct the various stages of manufacture. At Dholavira too from the occurrence of large quantities of sawn shell fragments representing shell debitage many of the techniques used for producing various objects could be reconstructed. The shell working technology used in the manufacture of bangles and ladles is very similar to the one reported for Mohenjodaro (Kenoyer 1984), Nageshwar (Bhan 1992), Kuntasi (Deshpande 1996; 2006), Nagwada (Bhan and Gowda 2003).

The chief shell raw material used were the three large marine gastropods *Turbinella pyrum, Chicoreus ramosus* and *Pugilina buchephala*. These have a more or less common source area of procurement the shallow intertidal coral reef areas in the Gulf of Kachchh. Here these molluscs inhabit the areas in colonies and can be handpicked at low tide. Considering the large-scale use of these shells during the harappan times, their collection was a regular fishery carried out probably under controlled supervison. Complete good quality shells in different sizes were regularly available to Dholavira shell workers. Although items like bangles require T*.pyrum* shells in a particular size range , small shells were also procured for other purposes such as inlays, libation vessels, bowls, etc.

Production of shell bangles appears to be the main focus of the shell industry wherein T*.pyrum* shells in a specific size range were preferred 50-200mm. This indicates the production of small sized bangles besides those of adult ones. Good quality shells were selected. These were prepared and then sawn to extract shell circlets of varying widths. Use was made of Copper/ Bronze saws which were the strongest for cutting the *T.pyrum* shells which are very sturdy shells and difficult to cut. After bangle extraction, the circlets were engraved with the chevron motif and then polished. While the remainng parts of

the shells were processed into other objects such as inlays, beads,. The internal thick columella was further made into rings, and conical objects. A maximum utilisation of the shells is observed.



Fig.11.68. ***T.pyrum*** **shell bangle debitage**



Fig.11.69. Sawn *C.ramosus* shell



Fig. 11.70. *C.ramosus* ladle manufacturing waste

11.2.5 Discussion

The preliminary investigations on the molluscan assemblage from Dholavira has yielded some interesting insights into the type of molluscan shells found at the site as well as the Harappan shell industry in existence then. The site although not located directly on the coast had witnessed the presence of certain marine estuarine molluscs such as *Anadara* sp, *Palcuna placenta, Paphia gallus, Thais carinifera, Telescopium telescopium, Terebralia palustris, etc.* these shells were naturally incorporated and do not show any evidence of use by the site inhabitants. However these were probably introduced due to natural factors like inundation, and human related activities. These can throw light on the local environment around the site. Especially shells of *Telescopium telescopium, Terebralia palustris,* indicate the presence of mangroves in the near vicinity. Occurrence of freshwater bivalves and gastropod shells also suggests flowing freshwater water bodies like a stream river or lake in the past. This is very much in contrast to the present day dry arid landscape around Dholavira today.

One of the Important highlights of the study is the identification of shell working activities at Dholavira. The large-scale presence of finished, unfinished shell objects along with their manufacturing waste strongly suggests the presence of a once flourishing shell industry during harappan times. This industry is comparable in magnitude with large Harappan centres such as Mohenjo-daro and Harappa. It was mainly involved in the manufacture of standard Harappan objects such as bangles, beads, inlays and miscellaneous objects. However production of certain objects like the bowls, inlays, ladles, objects made using the *T.pyrum* columella is observed which is not seen at most of the other Harappan sites in Gujarat. The manufacturing technology used is very similar to the one reported for Mohenjo-daro (Kenoyer 1984), Nageshwar (Bhan 1992), Kuntasi (Deshpande-Mukherjee 2006).

Since the study of the spatial distribution of all the shell debitage is in progress the exact shell working areas cannot be specifically identified. However occurrence of shell debitage from different areas within the settlement suggests

the presence of several shell workers residing at Dholavira. In future through temporal distribution an attempt will be made to reconstruct the changes both in shell working and its areas from the early levels of occupation till the later levels.

The vast array of shell objects both in quantity and kind indicates production on a large scale meant for both local distribution as well as for export to other settlements. These objects were used by the site inhabitants as ornaments, utility objects, in rituals, inlaid in wooden furniture, etc. These in a way reflects the stratified nature of the society using the objects which needs further investigations. For example use of shell ladles by certain sections of the society or the use of very small perforated complete shells of *Conus* sp. or *Nertita sp.* for a specific purpose. These aspects further probed will yield more insights into the day to day activities of the Dholavira inhabitants during the Harappan period.

11.3 Preliminary Analysis Report of Dholavira copper objects

Sharada Srinivasan

11.3.1 Introduction

Archaeometallurgical investigations were undertaken on fragments of copper alloy samples from Dholavira. These were collected following field study and in co-operation with Prof R.S. Bisht. Some of the preliminary investigations made on some of the specimens are reported further. These were samples of broken fragments of copper alloy artefacts many of which were corroded beyond recognition. Due to the coastal location, numerous samples showed heavy encrustation with copper corrosion productions. The investigations reported here include bulk analysis and micro-structural studies by mounting a cross-section of the specimen followed by polishing and etching. Lead isotope ratio analysis was also attempted on about 20 mg of filing collected from specimens such as from an axe fragment. Preliminary findings are reported further.

11.3.2 Summary of results

While the details of the analysis are given further, the preliminary results are summarised here. The bulk analysis of a corroded copper lump (found to have 80% copper) (Fig. 11.71) indicated very low trace element concentrations indicating lack of alloying and very high purity (Table 1), which may be a related to some metal processing such as a casting spill from its shape. The very low amounts of metallic trace elements indicating use of copper of high purity seems to suggest that the smelted or extracted copper may have gone through a process of refining. From the micro-structural investigations of a couple of specimens it is found that the use of unleaded low-tin bronze was prevalent. The fragment of a rod and the polished and etched structures (acc no 1862, Figs 11.72-11.76) indicate that it was made of unleaded low-tin bronze of about 5% tin which had been hot forged considerably after casting. This is indicated by the equiaxed grains with annealing twins due to hot forging and annealing in the centre of the specimens while some strain lines in the outer regions suggest that the surface had also been coldworked. In another copper alloy specimen (acc

no. DH 181, Fig. 11.77, 11.78), though it is heavily corroded, it is possible from the relic corrosion structure to make out that it was a two-phased structure that related bronze of about 12% since the network of alpha plus delta eutectoid is still visible around the alpha islands. From the shape, and from the lack of dendritic structure it may be inferred that some amount of annealing took place as it may have been forged a bit. A third specimen (DH-17) (Fig. 11.79), though heavily corroded showed remnants of bronze with about 5% tin and seems to have been as-cast from the presence of what may be reliced structures relating to the original dendritic structure of as-cast bronze. Scanning electron microscopy investigations on another copper fragment (Fig 11.80-11.82) indicated again the use of highly pure copper with the presence of some impurities of chlorine in some areas and sulphur in other relating to different regions of chloride and sulphidic corrosion.

In Srinivasan (2014) it is pointed out that a majority of artefacts in the Harappan context are of unleaded low tin bronze from a compilation of some 140 analysis from Indus Valley contexts in Chakrabarti and Lahiri (1996: 45-8); whereby there is a noticeable trend is that only 4-5 bronze objects have more than 2% lead.

Lead isotope ratio analysis, which is an archaeological provenancing technique was also attempted on a copper alloy sample (DH 496 Site DHR-1 103 / LOCUS: 47x84x3 / Stratum: 5 / Depth: -155cm) Lead isotope ratio analysis can be useful in tracing the sources of ores based on the principle that the isotopic ratios of lead remain unchanged from the ore source to the smelted metal, while the lead isotopic ratios differ measurably across ore sources in the world due to lead isotope geo-chemistry. Hence in principle on the basis of the lead isotopic ratio content it may be possible to identify the source of metal though there are many nuances in terms of successful identifications and there is also not comprehensive data on ore sources in the world to make meaningful comparisons. The sample had lead isotope ratios of Pb 208/207 2.43968; Pb 207/206: 0.846662 (Table 2) (undertaken by ICP-MS by T. Fenn at Univ of Arizona). One can only make preliminary comparisons at this stage since a complete data base of artefacts and Old World ore sources is needed to understand isotopic matches better, and differences in analytical methods can

also affect attempts at making lead isotope matches. In terms of possible data or ore sources for the Indus region there is still work to be done in terms of comprehensive data, nevertheless preliminary comparisons may be made with data compiled and analysed by Randall Law (2011: p. 440).

However these were analysed by the EDTA method, which though useful, has much less precision than lead isotope by TIMS (such as attempted on south Indian bronzes by the author as reported in Srinivasan 1999 at ISOTRACE Oxford Lab which has acquired standardised Lead isotope data from numerous old world sites) and also ICP-MS, which is also not as precise at TIMS.

From these as of now, only the source of Amba Kala in northern India seems to lie closer to this sample from Dholavira (Amba Kala; Law, 2010: 440, lead isotope ratios of 2.43-2.44 Pb 208/207; and Pb 207/206, 0.85-0.86). However, it is not a very close match and the analytical methods are also different so that the match is not conclusive, while one has to also explore the aspect of whether the region had mines in antiquity. Further investigations need to be attempted in these directions to more thoroughly explore aspects of provenance determination. Further details of micro-structure and technical analyses are given as follows.



Fig. 11.71: Corroded copper fragment from Dholavira

11.3.3 Analysis of mineralised copper waste from Dholavira (D-8264)

11.3.3.1 Macro-examination and bulk analysis

A specimen of mineralized copper waste, which was uncovered from the southern reservoir area, was analysed by bulk chemical analysis for compositional analysis for major elements and for trace elements (Atomic Mineral Division, Bangalore). The results of the analysis are given below:

Sample Code	D-8264
Cu (%)	80.81
S (%)	0.28
Ni ppm	1722
Co ppm	585
Pb ppm	110
Zn ppm	54
Fe ppm	2594
Cd ppm	<5
As ppm	1115
Sn ppm	57
Au ppm	<2
Ag ppm	970

Table 1. Bulk analysis of a specimen of copper slag/debris (AMD)

11.3.3.2 Observations

Although the specimen has the look of copper slag with an irregular surface, the analysis suggests that it is not copper slag but rather be oxidised/mineralized or corroded copper waste, perhaps from a casting process or even perhaps from oxidic smelting. (It may be noted that the composition of CuO is 80% copper and 20% oxygen).

Since it was found in the southern reservoir the nature of irregular nature of corroded surface can be explained perhaps as corrosion under water also suggested by the traces of sulphur that dissolves easily in water. The copper is unalloyed and all other metals are in trace amounts less than 1% indicating that it was of very high purity. It is possible that the extracted copper went through refining to get highly pure copper.

11.3.4 Micro-structural studies on copper alloy fragment from Dholavira (No 1862)

Micro-structural investigations were undertaken on a small fragment of a copper alloy rod. This was found in the region of the southern reservoir area (No. 1862, Lab No. DH 57, locus: 48*98, stratum: 10, depth: -580 cm) and was of 1 cm width and 4 mm thickness. The sample was sectioned and ground with a series of emery papers down to 600 grit size and then polished with diamond paste of 1-2 microns size. It was etched with a mixture of ammonium hydroxide and ammonium per sulphate.



Fig. 11.72: Corroded copper rod fragment from Dholavira

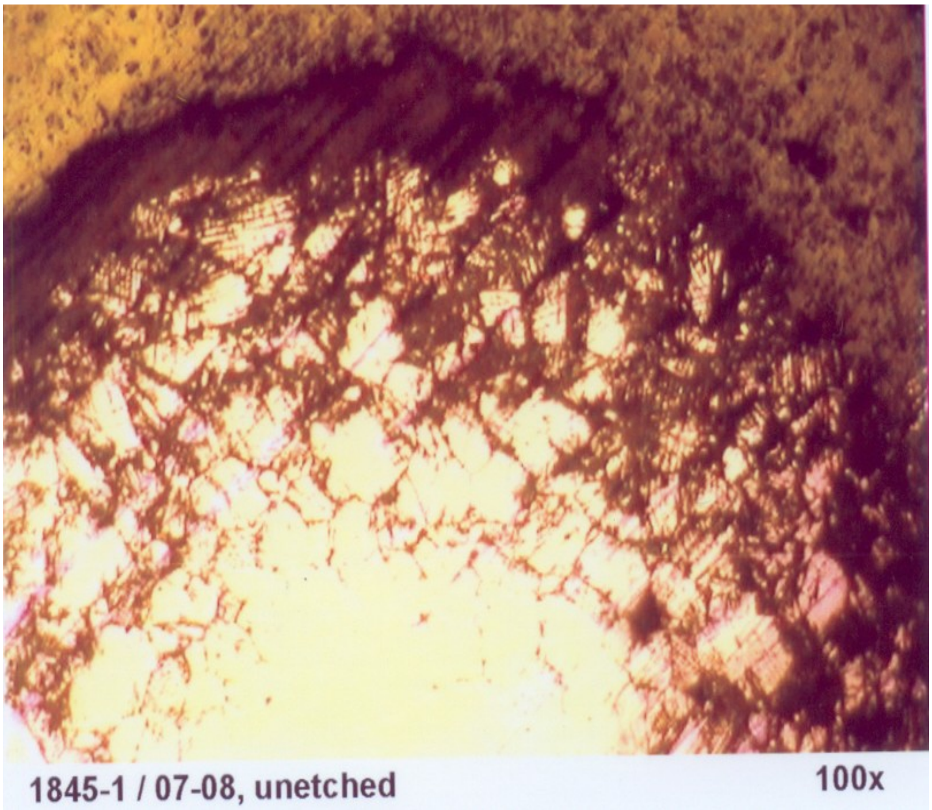


Fig. 11.73: Polished and un-etched micro-structure of copper rod fragment (DH 57)

Circular rod fragment, the unetched or polished structure reveals some relatively uncorroded inner core metal, surrounded by areas with more inter-granular corrosion around. The unetched inner metallic core is lighter and bronze coloured, suggesting it is not metallic copper.

This cross-section shows equiaxed grains of alpha bronze of about 5% tin (with a complete absence of eutectoid that would be present in higher tin bronze) and indicating annealing for long enough to break down the as-cast dendritic structure as indicated by the annealing twins. Some strain lines can be seen suggesting final cold working or shaping. The corroded area may be related sulphidic corrosion from the dark grey blue colour under optical microscopy.

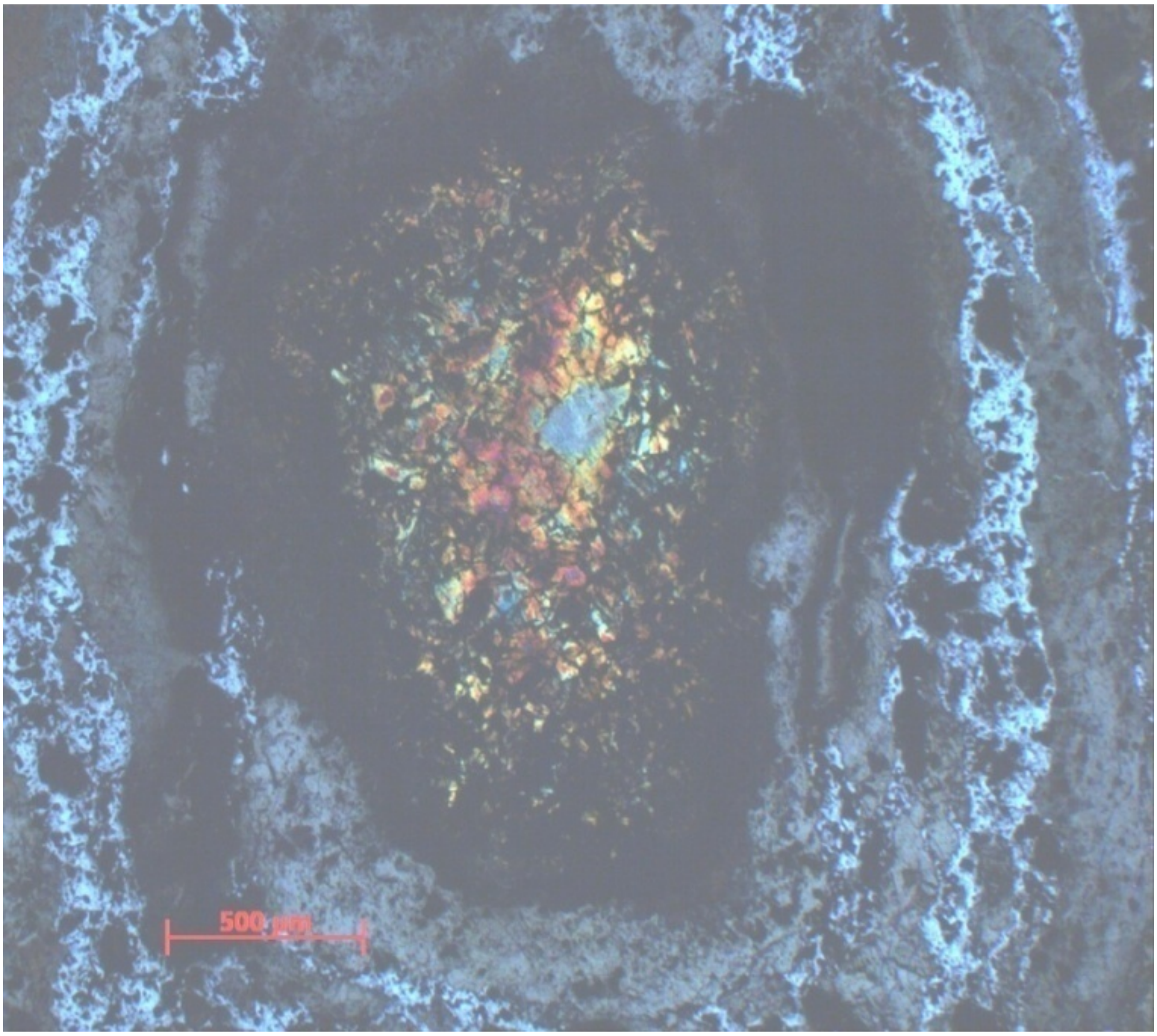


Fig 11.74: DH-57A Cross-section of sample showing small uncorroded metallic core

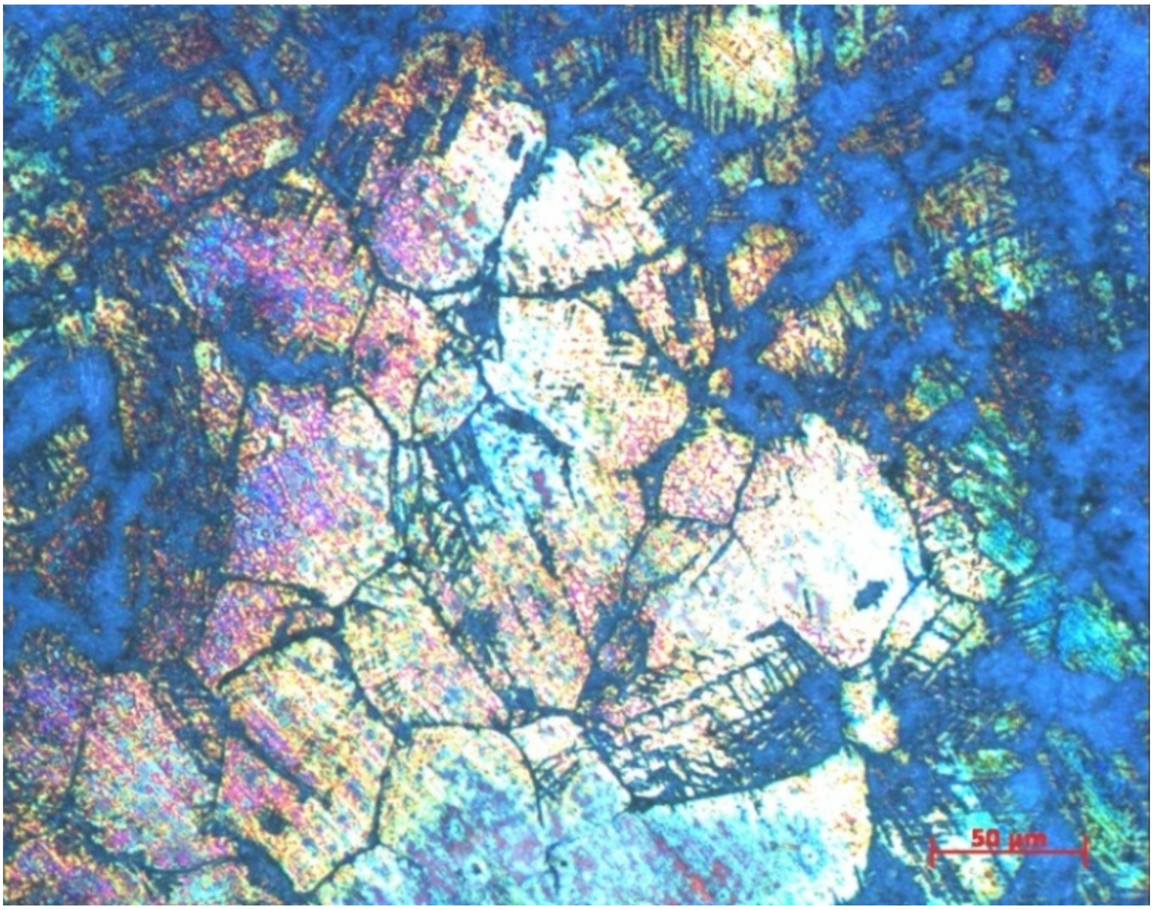


Fig. 11.75: Etched micro-structure (DH57A) showing strain lines from coldworking

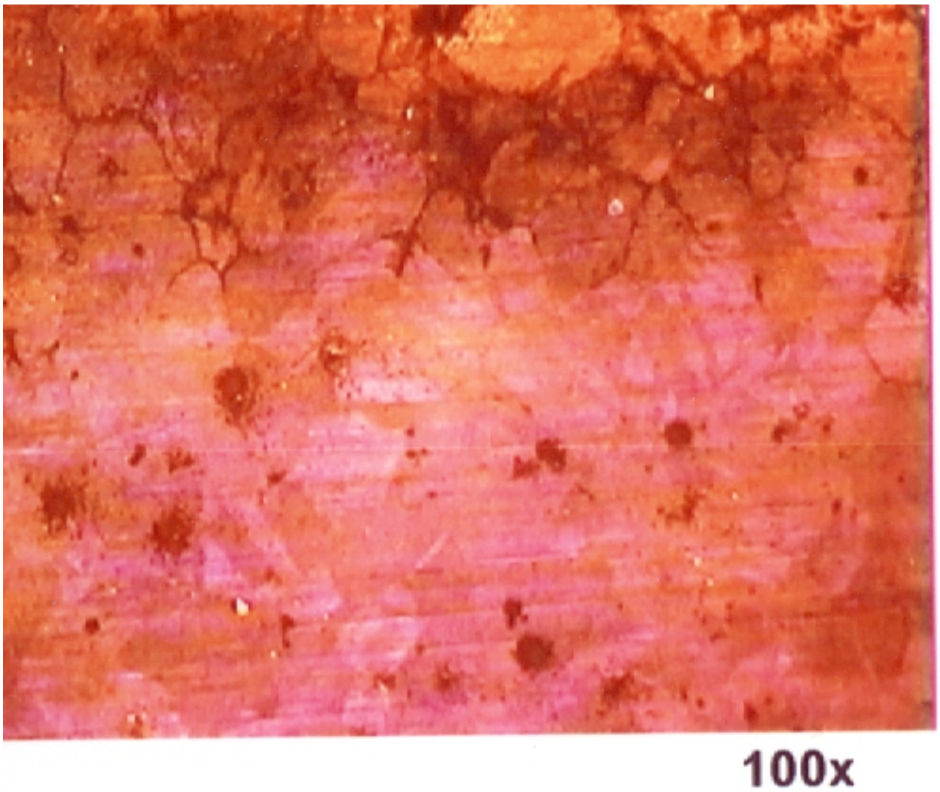


Fig. 11.76: Etched micro-structure of sample showing equiaxed grains

11.3.5 Microstructural Analysis of a copper alloy circular rod fragment (DH181)

Micro-structural studies were made on a copper alloy fragment (1 cm diameter), (DH 181, Locus: 47*84*1; Stratum: 5; Depth -139 cm) The sample was sectioned and ground with a series of emery papers down to 600 grit size and then polished with diamond paste of 1-2 microns size.. The cross-section reveals the presence of oxidised / corroded material with a few fine metallic patching. Although it was etched with a mixture of ammonium hydroxide and ammonium per sulphate this etchant did not show structure in the metallic patches, however the remnant corrosion clearly showed a reliced structure of 12% tin bronze as indicated by the alpha plus beta eutectoid network around the islands of alpha bronze.



Fig. 11.77: Copper alloy fragment from Dholavira

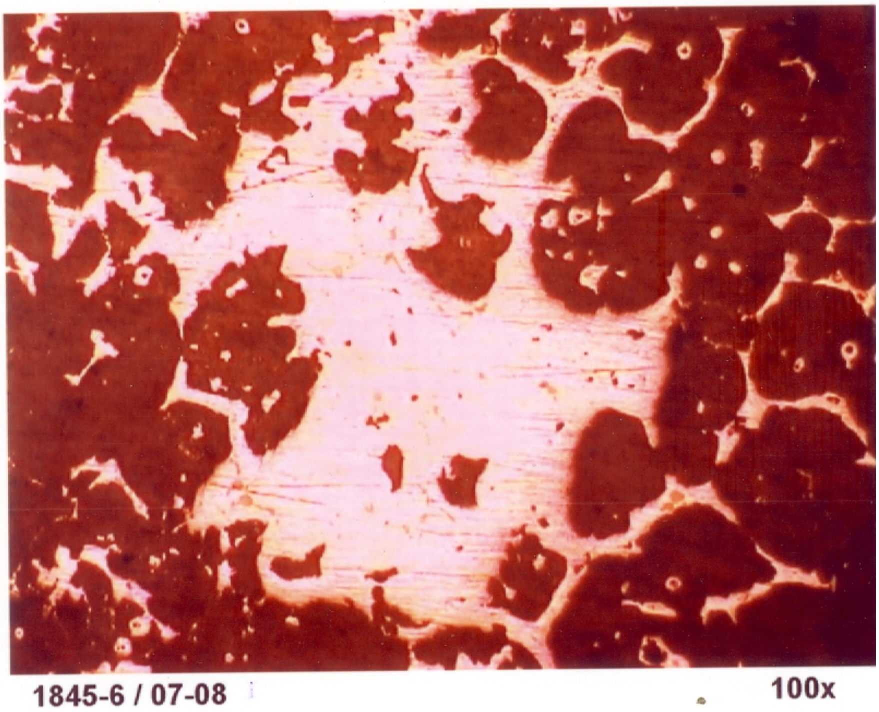


Fig 11.78: Etched micro-structure of copper alloy fragment (DH 181)

11.3.6 Microstructural Analysis of copper alloy specimen (DHO-17)

Microstructural study was done on a sample, which was mounted. It was ground with a series of emery papers down to 600 grit sizes and then polished with diamond paste of 1-2 microns size. It was observed in the polished condition, etched with ammonium hydroxide and ammonium per sulphate. The section reveals semi bright patches along with oxidised/ corroded material and cavities. Though very corroded, one could see dispersed through the matrix brighter regions related to the uncorroded metal. A very fine dendritic network is perhaps seen related to the as-cast structure is seen even the areas with corrosion which show ‘relic corrosion structures’, ie original metallic areas which are now corroded. The structure seems to relate to as-cast bronze with less than 5% tin. The presence of relic corrosion remnants relate to features where even when an artefact is significantly corroded, it may still be possible to make out the original structure of the metallic matrix from the shapes of the remnant corrosion structure.

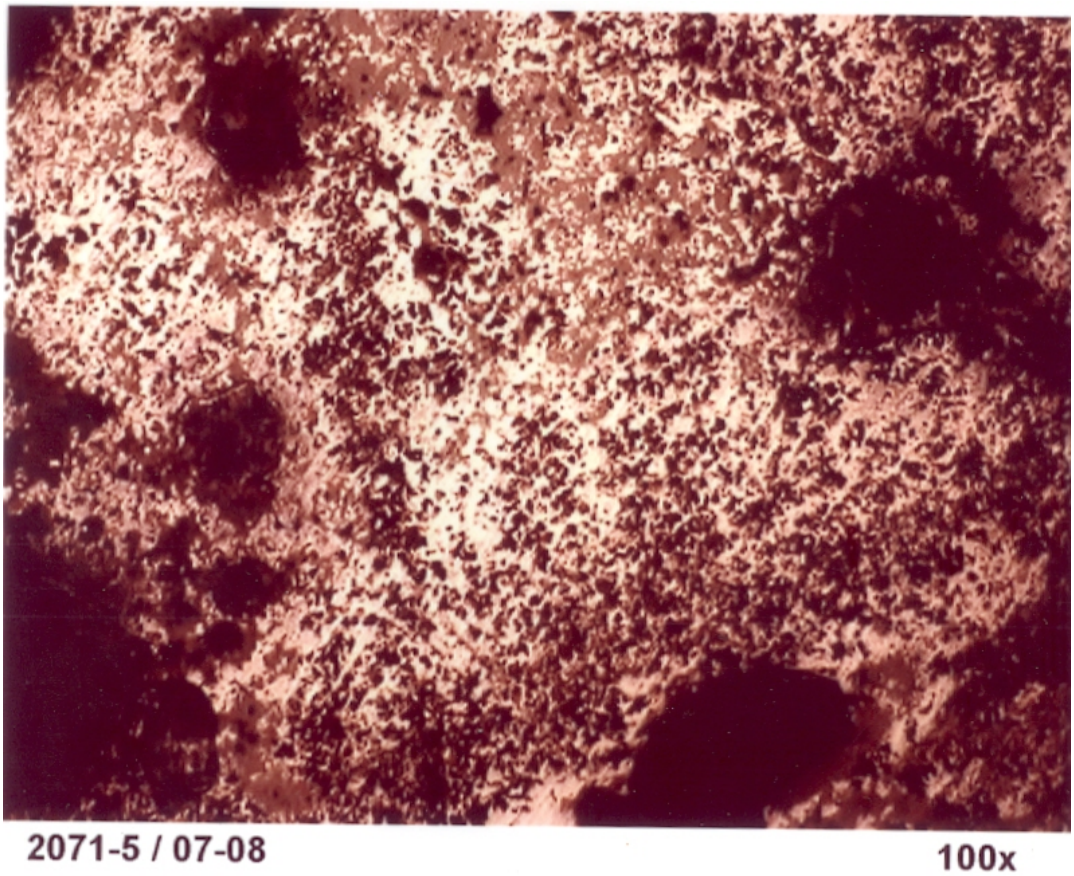


Fig. 11.79: Etched micro-structure of copper alloy fragment (DH 181)

11.3.7 Lead isotope analysis of copper alloy fragment from Dholavira

Lead isotope ratio analysis was undertaken on a specimen of a copper alloy fragment from Dholavira. The sample was from an unidentified fragment of a copper artefact (DH-496, Lab no Srini-3a, Locus 47x89x3, Stratum 5, Depth: -155cm). About 20 mg of sample was extracted from the specimen using micro-drilling and was then subjected to lead isotope analysis using MC-ICP-MS (ie multi-collector inductively coupled plasma mass spectrometer undertaken in collaboration with Thoman Fenn, Department of Geosciences, University of Arizona.

Pb 208/207 2.43968; Pb 207/206: 0.846662

NIST981 2σ External Error: 0.000278 0.000081 0.005567 0.004541 0.011626

Table 2 Lead isotope ratios of copper alloy sample from Dholavira (DH-496)

11.3.8 Test results from SEM analysis on corroded copper fragment from Dholavira

Scanning electron microscopy was attempted on a corroded specimen of a sample from Dholavira to get an idea of the composition or corrosion products. The investigations revealed that this was a specimen of corroded copper, with corrosion products and sulphur rich corrosion impurities in the darker areas and chloride rich corrosion impurities in the lighter areas. The use of unalloyed copper is seen in the presence of copper as the major element and absence of other peaks relating to minor elements such as tin or lead. The high purity of copper can be gauged from the absence of any minor peaks relating to trace metal elements. (The titanium peak in this case seems to related to the standard used and is not related the matrix of the sample). Prefential corrosion along the inter-granular grain boundaries towards the surface of the specimen is also notable. The SEM analyses were done with the co-operation of Indian Institute of Science, Bangalore through the good offices of Prof S. Ranganathan.

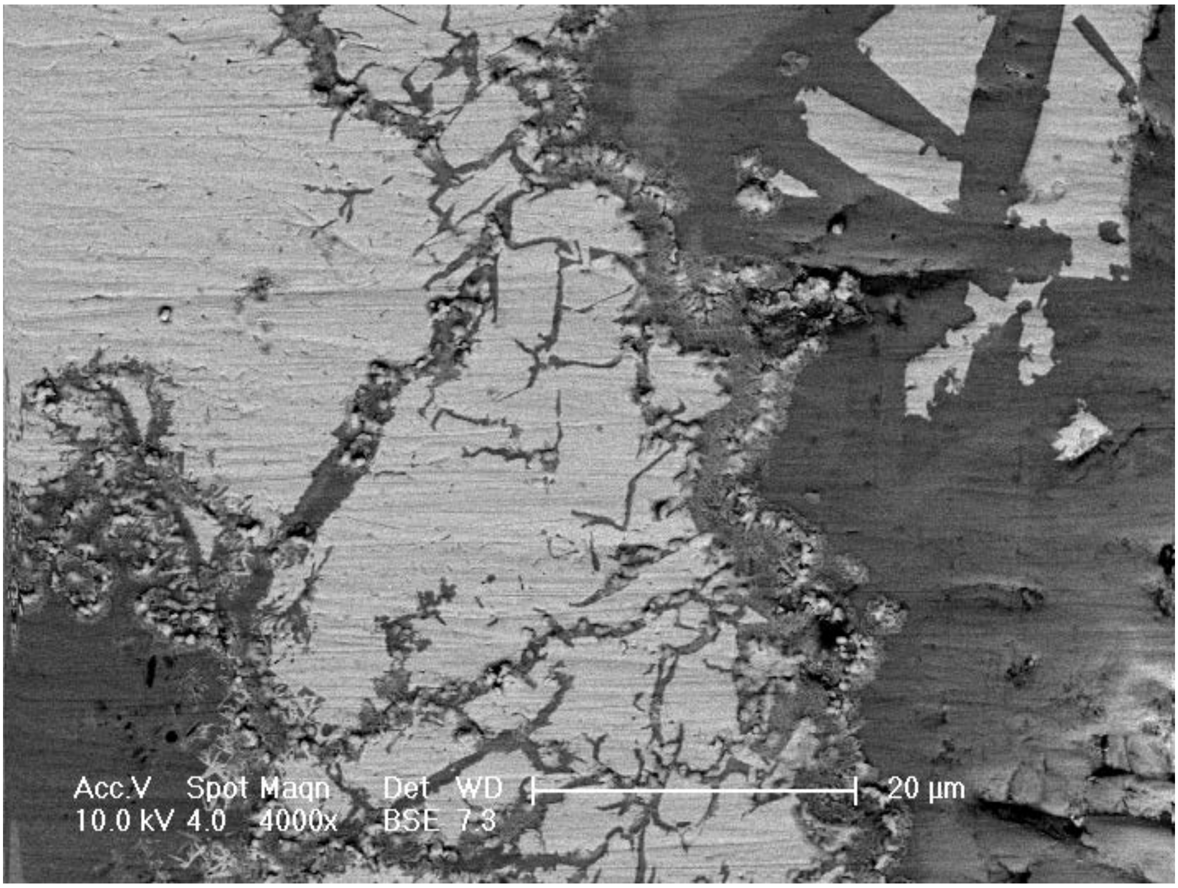


Fig. 11.80: SEM photomicrograph on specimen of copper fragment from Dholavira

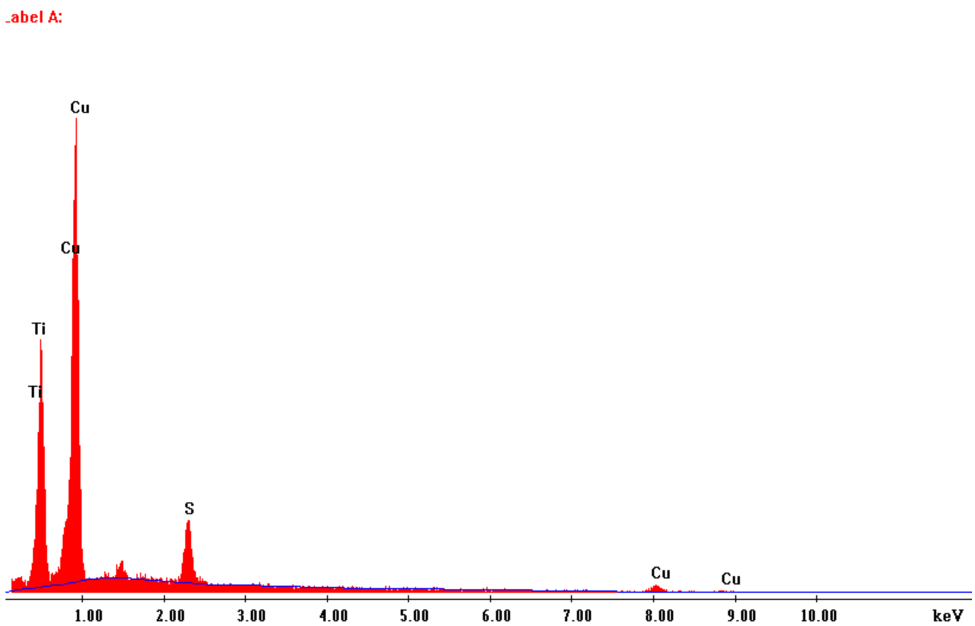


Fig. 11.81: Spectrum from analysis of the gray spot

Label A:

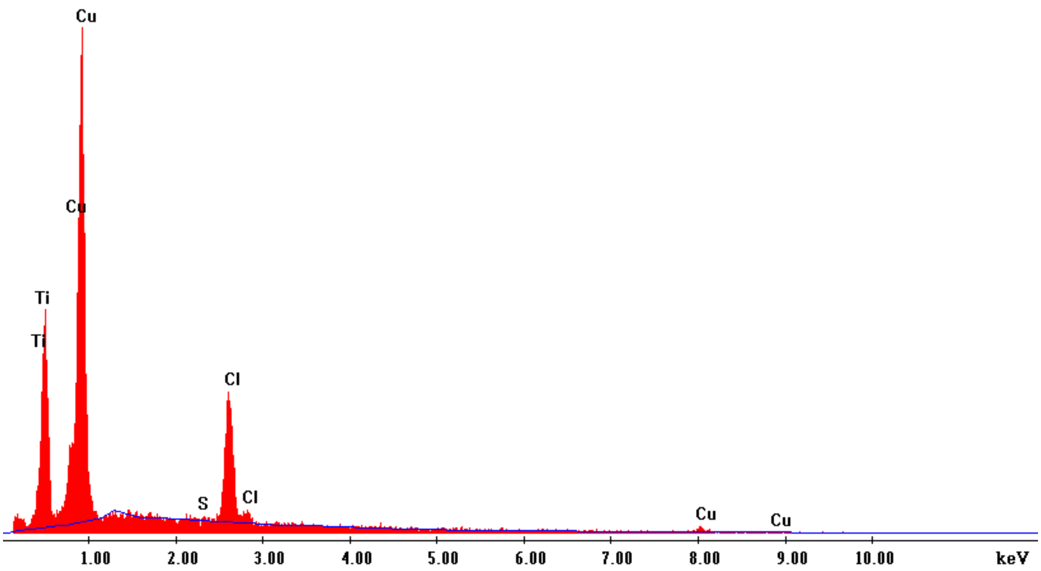


Fig. 11.82: Spectrum from analysis of the light spot

References

1. Srinivasan, S. 2013, 'Megalithic and surviving binary high-tin bronze traditions in southern India: Tracing binary bronze usage to Harappan times', *Transactions of the Indian Institute of Metals,* Springer, 66 (5-6): 731-737.
2. Randall Law, 'Inter-Regional Interaction and Urbansim in the Ancient Indus Valley', A Geological Provenience Study of Harappa's Rock and Mineral Assemblage', Current Studies on the Indus Civlisation, Vol VIII, Part I: Text., Mahohar, 2011, Rihn-Manohar Indus Project Series
3. Chakrabarti, D.K. and Lahiri, N., 1996, Copper and its alloys in ancient India, Munshiram Manoharlal.

11.4 Copper Metallurgy in the Kutch (India) during the Indus Civilization: First Results from Dholavira

David Bourgarit, Nizamuddin Taher,
Benoit Mille & Jean-Pierre Mohen

In the framework of the Indo-French collaboration for the adanced scientific sudty and characterization of antiquities and art objects, samples coming from the Dholavira excavation s (Bisht 1999) have been studied at the Centre de Recherché et de Restauration des Musées de France[1]. The samples are related to a metallurgical activity: slags, crucible fragments with adhering slags, metallic waste, as well as a copper pin were observed and analysed. The first results clearly indicate a diversified local metallurgical activity in this major site of the Indus Civilization. Smelting and/or copper refinement took place on the site, bronze alloying was also performed. Moreover, these results bring to light an original metallurgy characterized by a surprising ubiquity of lead. The archaeological context and the references appear in Table 1.

Table 1 – Sample from Dholavira related to a copper –metallurgy activity studied at the C2RMF

Type	Designation	Locus	Stratum	ASI. n°	Lab. n°
Copper slag	Slag	58 x 3 x 2 -10, 15 m	7A?	A-5	L29696a
	Slag				

[1] This Indo-French cooperation for the advance scientific study and characterization of antiquities and art objects has been launched in 1998, with the visit of Professor V.S. Ramamurthy, Secretary of the Indian Department of Sciences and Technology, to the Centre de Recherche et de Restauration des. Musees de France (C2RMF), in Paris, The C2RMF is the French partner in the project, the Indian counterparts being the Institute of Physics (IoP), the Archaeological Survey of India (ASI), and the National Museum. As a target of the project, the setting up by the Indian authorities of a laboratory similar to the C2RMF was envisaged. In order to achieve this goal, two seminars and several exchanges of visits of scientists from one country to the other have taken place, along with the training of two Indian scientists at the C2RMF : a doctor in Physics of the IoP, Dr. Ravi Prasad, and an archaeologist, Dr. Nizamuddin Taber of the ASI. Many thanks to J. C. Dran and A, Bouquillon (C2RMF) for their critic reading of the manuscript, We are grateful to Prof, R.S.Bisht from ASI for supplying the Dholavira samples, and to the French Embassy at New Delhi (B. Fleutiaux & 1. Ghose) without whose financial support the work would not have been possible.

	Slag				
	Slag	XE x 23 x 2	7A	C-50	L29829
Crucible	Fragment of crucible with adhering slag	Citadel	Upper levels	A-3	L29694
	Fragment of crucible with adhering slag	47 x 7 x 2 -1,50 m	3 ?	A-4	L29695
	Fragment of crucible with adhering slag	58 x 11 x 2, annexe	5	C-10	L29827
Metallic Copper	Copper waste	37 x 71 x 3, mini stadium	5	C-54	L29830
	Copper pin	55 x 84 x 1 +2	Surface	B-16	L29537

11.4.1 Experimental conditions

The bulk samples have been observed under light macro-photography. Cross sections of all samples have been made by embedding in epoxy resin and SiC polishing (for the metallic samples a [mal polishing with alumina has been performed). They were examined by means of light binocular lens, reflected light optical microscopy, and scanning electron microscopy (SEM JEOL 840). The metallic pin fragment was also etched (alcoholic ferric chloride / aqueous ammonium persulphate) in order to reveal further features of its microstructure.

Local elemental analyses were performed with the EDS (Energy Dispersive Spectrometry) system attached to the SEM, on the polished sections. Local elemental analyses were also performed by means of Particle Induced X-ray Emission with the Ion beam facility AGLAE (beam spot Ø ≈ 100 μm, see Dran *et al. 2000): d*irectly on the slags before being sectioned, and for the metallic objects on the polished sections.

The global structural composition of some of the samples was determined by powder X-ray diffraction (Siemens D5000).

11.4.2 Results and discussion

11.4.2.1 Copper “slags”

The four samples have approximately the same size, a few centimetres, and can be separated into two groups on the basis of the presence or not of a siliceous vitrified phase, and according to the structure of the former copper prills (Fig. 11.83, Table 2 for the results of elemental analysis).

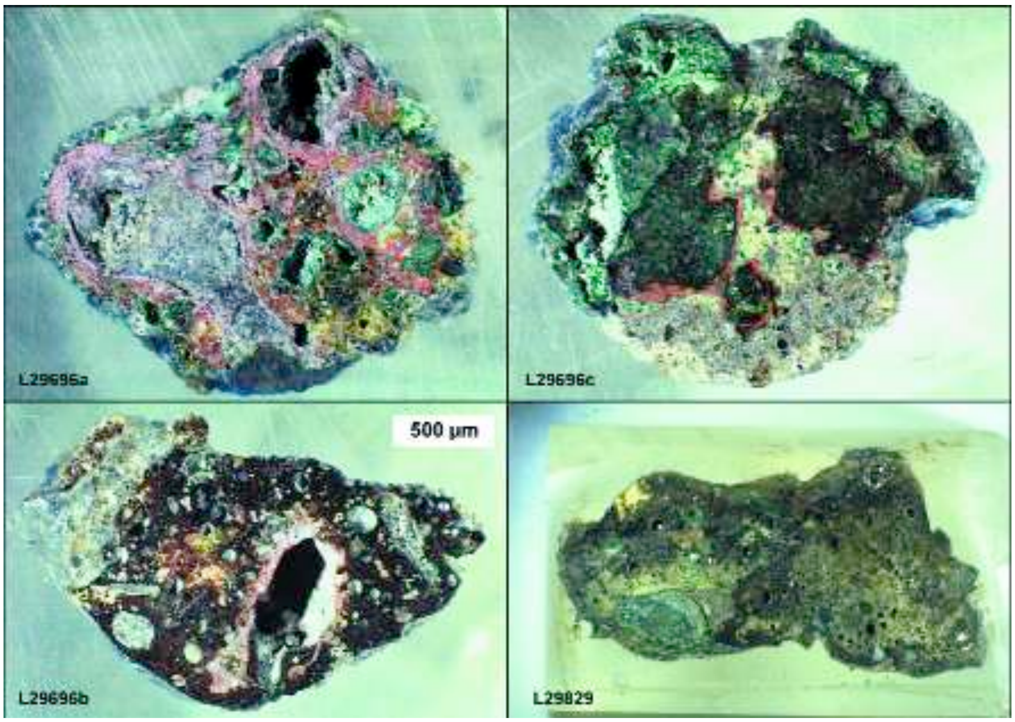


Fig. 11.83 - Cross-sections of the four "slags" sample 29696c does not show any large "slaggy" mer metallic copper (now copper chloride) are systematically visible, except on 29696b.

Table 2 - Elemental analysis by the EDS system attached to the SEM. All results are in weight oxide percentages
(nd = non detected i.e. less than 0.5 wt%)

Lab. N°	Localisation	MgO	Al_2O_3	SiO_2	P_2O_3	SO_3	Cl	K_2O	CaO	Fe_2O	CuO	As_2O	ZrO_2	PbO
COPPER SLAGS														
L29696c	Matrix	nd	6,4	50,8	nd	nd	20,3	nd	2,4	3,8	15,9	nd	nd	nd
L29696a	Glassy matrix	2,7	6,6	42,4	2,0	nd	nd	1,7	19,3	2;8	20,2	1,2	nd	nd
L29829	. Glassy matrix	nd	3,6	31,9	nd	nd	nd	1,2	6,1	33,6	nd	1,7	1,8	17,7
L29696b	Glassy matrix	2,1	3,6	34,8	1,8	0,64	nd	1,4	11,8	17,1	2,7	1,5	nd	24,1
CRUCIBLE FRAGMENT WITH ADHERING SLAG														
L29695	Glassy matrix	1,4	7,3	48,0	nd	nd	nd	0,79	12,8	2,7	22,4	1,6	nd	nd

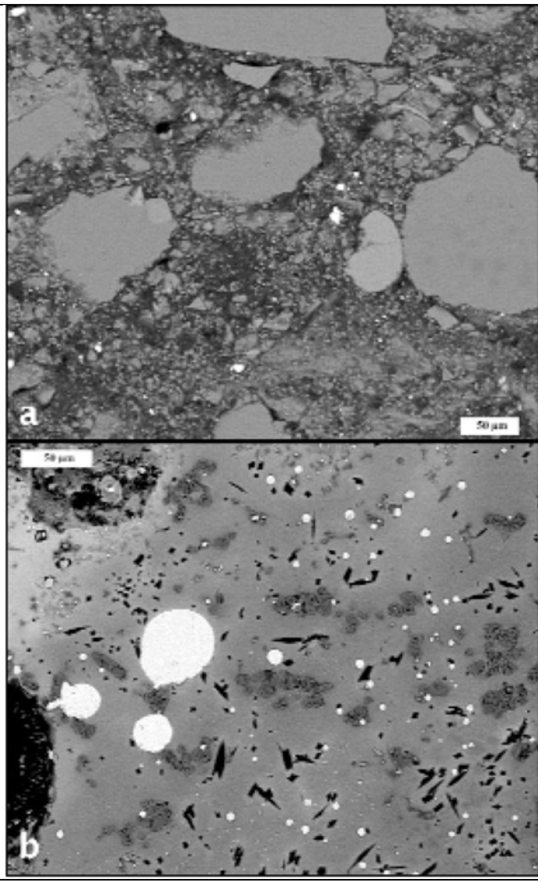


Fig. 11.84 - Electron micrograph (backscattered electrons) showing the differences of the siliceous phases among the two groups of wastes. (a) In 29696c it is a conglomerate of non-fused clay and quartz grains. (b) In the three other wastes the siliceous phase is vitrified, and exhibits magnetite-like grains (light grey), augite-type needles (black), as well as metallic copper prills (white, containing 4 wt% of arsenic).

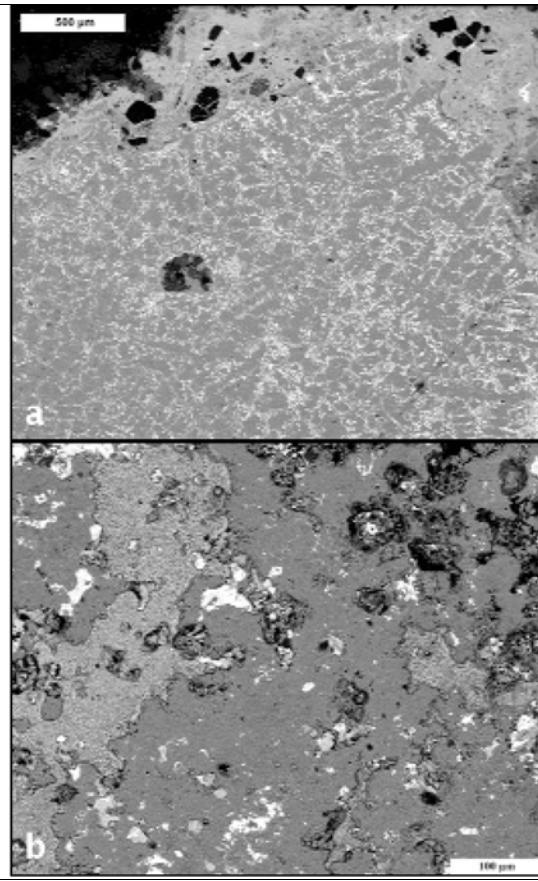


Fig. 11.85 - Electron micrograph (backscattered electrons) showing the differences of microstructures of the copper-chloride prills in the two groups of wastes. (a) In 29696c a dendrite-like segregation in the Cu-Cl-O matrix (grey) exhibits both Cu-S (light grey) and Cu-Pb-As-O (white). (b) In the other wastes a Cu-Pb-As-Fe-Sn rich copper chloride (white) appears as inclusions and not as a dendritic structure in the Cu-Cl-O matrix (dark grey), a Cu-Cl phase without oxygen is also to be noticed (light grey)

Some micrometric lead oxide prills were also found in the glassy matrix (29696b). The non-fused quartz remains a major component of the slags. Another feature differentiating the two kinds of wastes is the structure of the former copper prills now corroded into copper chloride (identified as atacamite CU2Cl(OH)3 on sample L29829). In sample 29696c it still exhibits a dendritic structure, as shown by SEM observations and local analysis (Fig.11.85a). The global analysis of the prill

gives about 4 wt% of arsenic and more than 10 wt% of lead. In the other group, the structure of the former metal is quite different, since the Cu-Pb-As-Fe-Sn oxide appears as inclusions and not as a dendritic structure (Fig. 11.85b). In 29696a, some silver chloride is found together with copper oxide prills. Some much smaller prills (a few µm) of still non-corroded metallic copper were also observed in sample 29696b, containing 4 wt% of arsenic (Fig. 11.84b).

"Slag" 29696c is probably a copper droplet which has fallen on the soil. The high quantity of lead may be due to an intentional alloying. For arsenic, the alloying is far less clear since natural copper ores bearing arsenic can easily lead to metallic copper with a high arsenic content (see Pollard *et al. 1989).*



Fig. 4 - Cross-section of the sample 29695 viewed by binocular lens, showing the structure encountered in all three crucible fragments with adhering slag: the layer adhering to the clay is a glassy siliceous phase rich in calcium and aluminum

The features of the three other samples clearly assign them to copper slags, that is used siliceous remains of a copper metallurgical activity. The slags are too big to be part of the vitrified layer of a crucible fragment impregnated with fused metal (see the crucible fragments studied hereafter), thus an alloying or melting activity can be eliminated. Then two possibilities remain, copper smelting and copper refinement, It is difficult to distinguish between them without any additional data concerning the archaeological context (see discussion in Carozza *et al.* 1999).

However this metallurgical activity can already be well characterized:

- high temperatures were involved (more than 1100 "C, see Bourgarit and Mille 1999);

- the presence of magnetite spinel Fe_30_4 indicates highly oxidising conditions. This would support the refinement hypothesis, but smelting has been proved having already been performed under such oxidizing conditions, at least in Chalcolithic contexts (see Mille and Bourgarit 1998, Hauptmann *et al. 1996);*

- the small size of the slags is to be noticed, since large-scale late Bronze Age smelting sites produce rather big slags (see Rothenberg 1990). Are the present samples fragments of bigger ones? The big size of the copper prills makes us assume that the original slag was quite big;

- the question of the copper ores involved in this activity is here difficult to solve. Often iron and sometimes silver were detected, and in one slag (29829) some tin was identified as Pb-As-Sn-Fe rich inclusions in the former metallic copper prill. These elements may come from the copper ore, although iron may come from an addition of flux;

- the huge amounts of lead are still more disturbing, since they are not only present in the former copper metal, but also are often a major component of the glassy matrix (up to 24 wt% PbO !). So much lead could hardly have been brought by the copper ore alone, it may have been added intentionally. For alloying? We have already discarded the hypothesis of alloying activity, thus if lead would have been added, it would have been as a fluxing agent. This would then mean that the slags are smelting remains. Moreover, this would be the only known example of such a process in copper extractive metallurgy.

11.4.2.2 The crucible fragments with adhering slag

In all three samples the layer adhering to the clay is a glassy siliceous phase rich in calcium and aluminium (Fig. 11.86, Table 2). Copper is to be found in huge amounts, as millimetric and rnicrometric prills of former metallic copper now corroded into copper chloride and copper oxides (identified in sample L29827 as clinoatacamite $Cu_2(OH)_3Cl$ and cuprite CU_2O). Arsenic is systematically present in the glassy matrix, being dissolved in the glass. Moreover tin is also systematically present in the surface layer. Beside these similarities among the three samples studied, we can distinguish two different types of layers;

- on samples L29694 and L29695, the glassy siliceous matrix reveals large amounts of dendritic copper oxide, together with silicate needles rich in aluminium and calcium. Tin is to be found in its oxidic form SnO_2, either as unshaped prills or as needles (Fig. 11.87);

- on specimen 29827 the glassy siliceous matrix does not exhibit these dendritic copper oxides, neither the silicate needles. Instead we have identified large amounts of iron oxide of the magnetite spinel type Fe_3O_4containing a lot of nickel. Also many copper sulphide prills are observed. Moreover, tin is not in an oxidic form but as metal, trapped in a silicate phase rich in iron and calcium (Fig. 11.88).

The three fragments of clay crucibles presenting a vitrified layer on one side are without any doubt associated with a copper metallurgy activity. The clay has undergone very high temperatures, with heating from above (Tite *et al.* 1990; Carozza *et al.* 1999). Here the question of smelting seems out of purpose, since the massive presence of tin is probably due to an intentional addition. Hence these crucibles could very probably have been used for alloying copper and tin in order to make bronze.

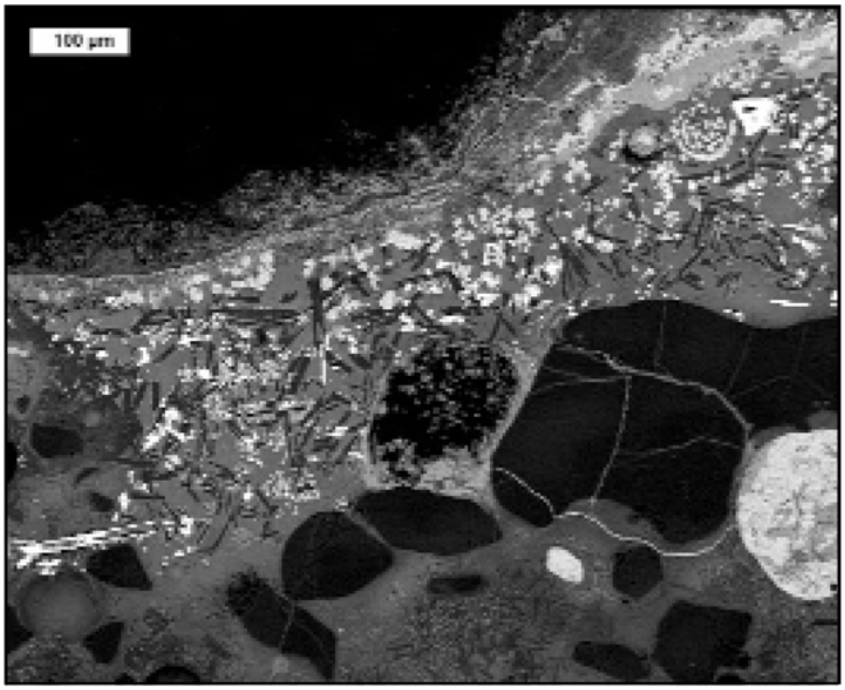


Fig. 11.87 - Electron micrograph of the sample 29695 (backscattered electrons) showing a glassy siliceous matrix (grey). Copper is present as large amounts of dendritic copper oxide (light grey), together with silicate needles rich in aluminium and calcium (black). Tin is to be found in its oxidic form, either as unshaped prills or as needles (white).

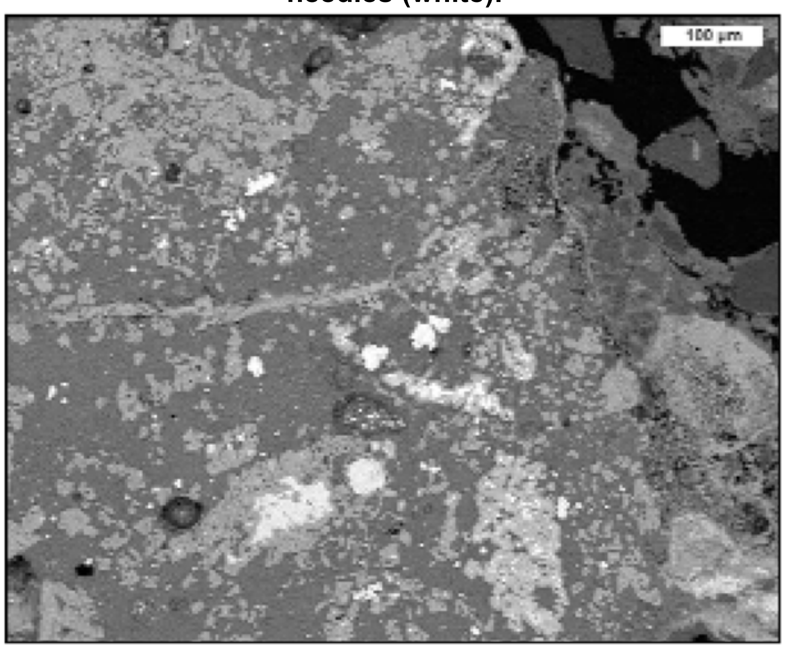


Fig. 11.88 - Electron micrograph (backscattered electrons) showing, for specimen 29827, a particular slag layer structure: the glassy siliceous matrix exhibits large amounts of iron oxide grains of the magnetite spinel type Fe_3O_4 containing a lot of nickel (light grey); many copper sulphide prills are also observed (white); moreover, tin is not in an oxidic form but as metal (white), trapped in a silicate phase rich in iron and calcium (light grey.)

Some features in samples 29694 and 29695 are very similar to those of the crucibles found at Fort Harrouard (Mohen & Walter 1994), and in particular the occurrence of tin-oxide needles. Does it mean that in these two crucibles alloying was done by adding directly cassiterite $Sn0_2$ to copper, as suggested at Fort Harrouard (France)? And would that mean in turn that for crucible 29827, where metallic tin was found, another process was involved? Once again details of the archaeological context are missing to ensure one hypothesis or the other. For instance the slags may have been weathered differently (see Bachmann 1982), changing or not the oxidation state of tin.

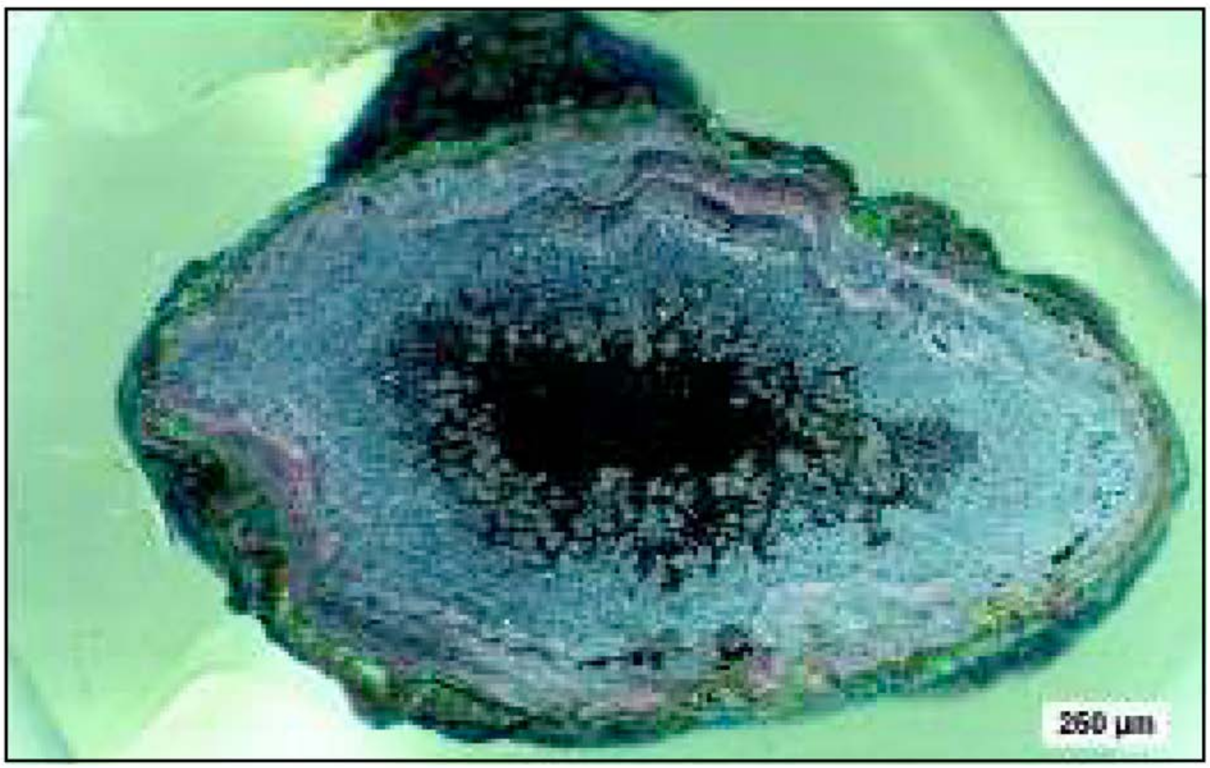


Fig. 7 - Cross-section of the metallic copper waste 29830 viewed by binocular.

The large amounts of arsenic are still puzzling and, as in the copper slags, they may indicate that the original copper ore contained much arsenic.

11.4.2.3 Metallic copper

A metallic copper waste has been studied (29830, Fig. 11.89), as well as a pin fragment (29537, Fig. 11.90). Both samples contain much arsenic (from 1 to 3

wt%). Some nickel and iron are also systematically present, and in prill 29830 some cobalt was detected (Table 3).

Table 3 – Elemental analysis by PIXE of the copper samples. All results are in weight percentages

Designation	Lab n"	Fe	Co	Ni	Cu	Zn	As	Ag	Sn	Sb	Au	Pb	Bi
Pin fragment	L29537	0,4	< 0,1	0,4	95,8	< 0,1	3,3	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1
Copper waste	L29830	0,5	0,1	0,2	98,3	< 0,1	0,8	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1	< 0,1

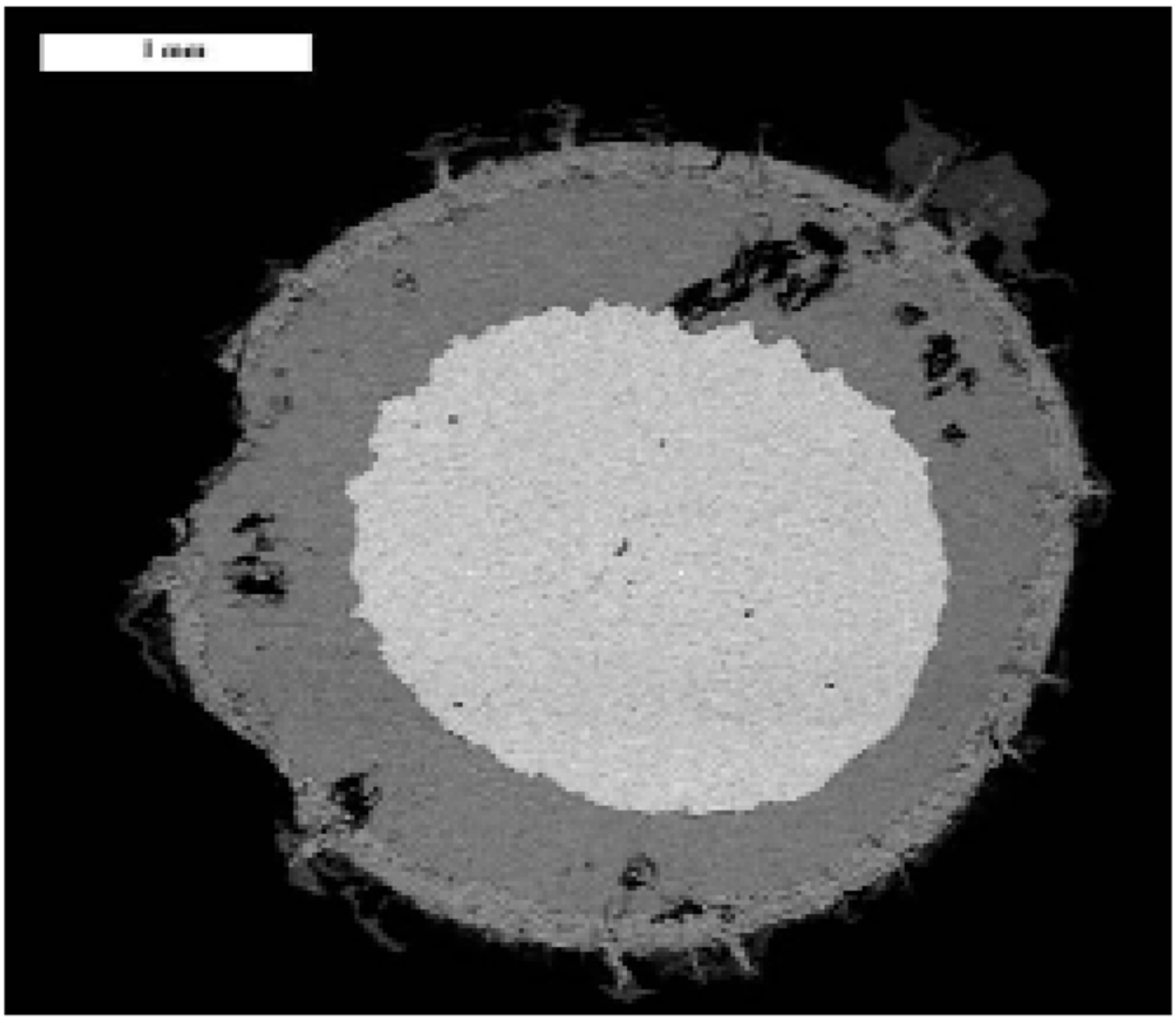


Fig. 11.90 - Electron micrograph (backscattered electrons) showing the cross-section of the metallic copper pin 29537.

The cross section of pin 29537 reveals a large amount of copper sulphide inclusions rich in iron, and some inclusions of copper-iron mixed oxide (Fig. 11.91a).

The copper sulphide inclusions are very small, have an isotropic shape (at least in the cross section plane) and are distributed on a rather homogeneous manner; arsenic shows no segregated phase, it is all in solid solution. The pin cross-section shows after etching some annealing twins across the grains (Fig. 11.91b).

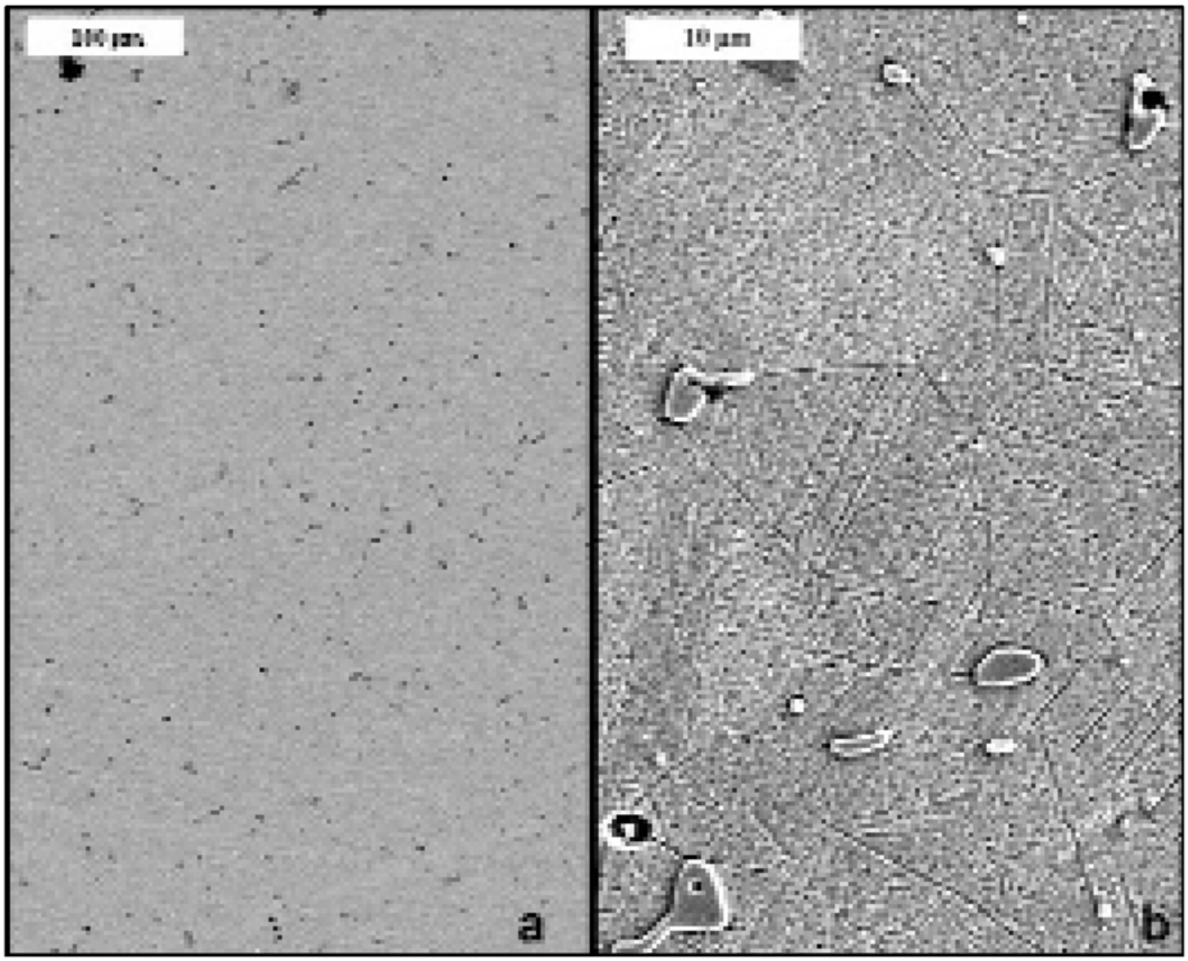


Fig. 11.91 - Electron micrographs (backscattered electrons) showing e metal microstructure of the pin 29537. (a) a large amount of copper sulphide inclusions rich in iron, and some inclusions of copper-iron mixed oxide are to be seen. (b) after etching some annealing twins appear across the grains.

The cross section of the prill 29830 shows also numerous iron-rich copper sulphide inclusions, but here they are distributed as a coarse "droplet structure", and most of the arsenic is confined in a second phase Cu_3As (Fig. 11.92).

The association of iron and sulphur found as inclusions in large quantities may reveal that some sulphideore containing iron was used. This copper ore

contained also some arsenic and nickel. Concerning the microstructures, the huge differences noticed between the two samples may assign them to two opposite steps in the metallurgical process:

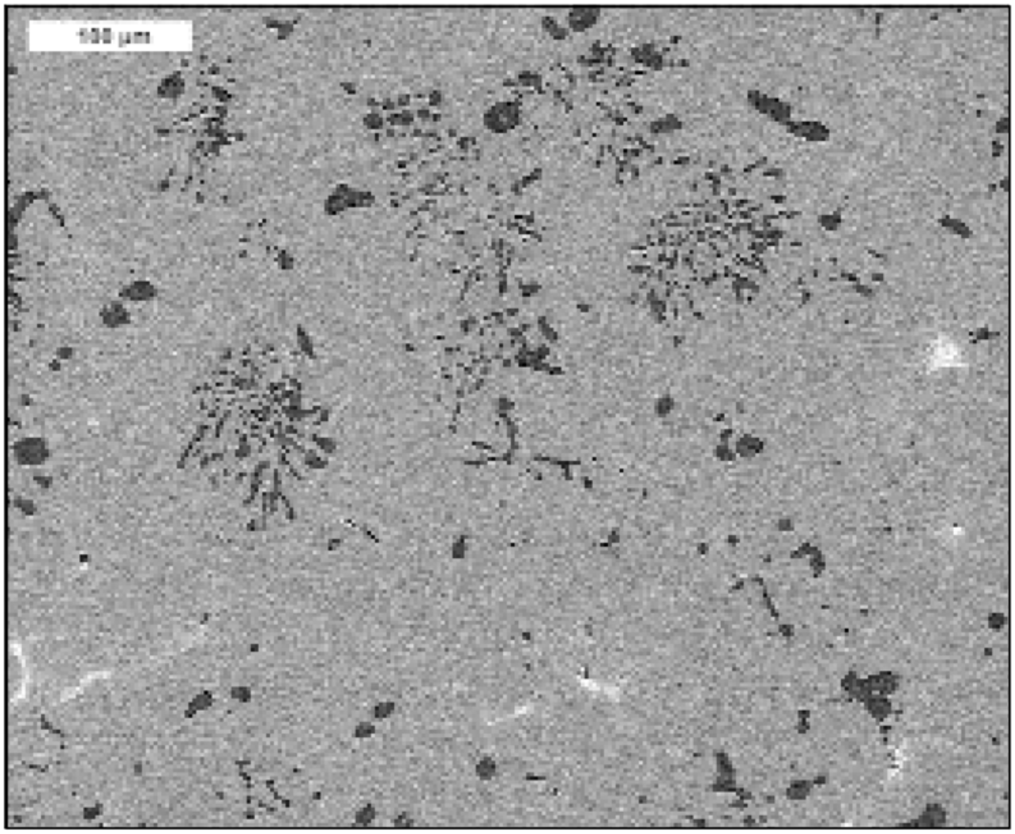


Fig. 11.92 - Electron micrographs (backscattered electrons) showing the metal microstructure of the metallic waste 29830, where the numerous copper sulphide inclusions (dark) are distributed as a coarse "droplet structure", and most of the arsenic is confined in a second phase Cu_3As (white)

Copper prill 29830 shows a coarse copper-sulphide "droplet structure" which is commonly found in rough copper ingots: this sample is probably one of the first products obtained after smelting.[2] On the contrary, the copper pin has undergone several thermo mechanical treatments. First the annealing twins observed reveal that the metal has recrystallised: the metal has certainly been mechanically worked (probably cold hammered) and annealed, possibly along several steps. Moreover, the absence of a second phase Cu_3As indicates that the pin has undergone a total

[2] By the way, the presence of a second phase Cu_3As confirms the possibility of such a phenomenon in low-arsenic copper (the global analysis by PIXE gives 1 wt%, see discussion in Budd and Ottaway 1989).

thermal homogenisation. Such a treatment is rather unusual since this second phase is known to be difficult to remove: to achieve this the pin has been held at least 30 minutes at more than 600°C. (see Northover 1989; Budd 1991). The reason of such a homogenisation is not clear; maybe it has been performed in order to soften the metal in dissolving the second phase responsible for structural hardening.

11.4.3 Conclusion

The study of these samples clearly indicates a copper metallurgical activity at Dholavira, involving high temperatures. This activity is very diversified, though in most cases it was not possible to ascertain its exact nature: the slags could be associated either with copper smelting or with copper refinement; the copper prill seems also related to a smelting activity and the crucibles were clearly dedicated to bronze alloying. The only manufactured copper artefact studied, a pin, results from a high degree of processing and establishes evidence of a good knowledge of the thermomechanical treatments of copper metal. However since the object may have been imported, it does not show that this knowledge belongs to local craftsmen.

Two features are particularly worth pointing out, since they are common to most of the investigated samples:

- -large amounts arsenic is present in all samples, suggesting an arsenic-rich copper ore;

- lead is found everywhere, not only associated with metallic copper or former metallic copper, but as one of the major compound of the glass of the slags. For the copper slags, this lead presence led us to the unusual hypothesis. concerning its use as a fluxing agent during copper smelting.

    - All these results suggest that a diversified and original metallurgical activity was taking place at Dholavira, involving different skills. These

suggestions are now to be investigated more in-depth, since many questions remain unanswered, and in particular the crucial question of copper smelting: was it performed at Dholavira or not? The studied slags could have been produced by smelting, but also by refining, and only the association of these samples with their archaeological context may lead to a firm answer: are the slags associated with. furnaces, with tools, are there workshops, what is the size of the slag deposits, etc.?

- o However the very question of the metallurgical activity cannot be answered without an extensive study of the manufactured copper-based objects themselves. It is the only way to characterize this metallurgy as a whole, since only artefacts are sufficiently documented (date, function, social position, quantity, typology, technical difficulty) to answer the basic questions (see for example Bourgarit *et al. 2003):*

- what were the technical levels and skills and their evolution: mastering of alloying for specialized tasks, mastering of the impurity content to achieve forming (foil, casting ....) and to ensure good mechanical resistance;

- what were the means of copper exchanges and their evolution?

References

1. Bachmann, H.G. (1982) the identification of slags from archaeological sites. *Occasional Publication n°6.* Institute of Archaeology, London.
2. Bisht, R.S. (1999) Dholavira & Banawali: Two different paradigms of the Harappan Urbis Forma. *Puratattva, Bulletin of the Indian Archaeological Society* No 29 1998-99. New Delhi, Pp. 14-45.
3. Bourgarit D., Mille, B. (1999) La métallurgie chalcolithique de Cabrières: confrontation des données expérimentales et archéologiques en laboratoire. *Archéologie en Languedoc*, no 21, pp. 51-63.
4. Bourgarit, D., Mille, B., Borel, T., Baptiste, P. & Zéphir, T. (2003) A Millennium of Khmer Bronze Metallurgy: A Technical Study of Seventy-five Bronze Artefacts from the Musée Guimet and the Phnom Penh National Museum,

50th Anniversary Symposium on Scientific Research in the Field of Asian Art, Freer Gallery, 27-29 sep. 2001, Washington, pp. 103-126.

5. Budd, P. & Ottaway, B.S. (1989) The properties of arsenical copper alloys: implications for the development of eneolithic metallurgy, in Archaeological sciences 1989. *Proc. of a conf. on the application of the scientific techniques to archaeology*, ed. P. Budd, B. Chapman, C. Jackson, R. Janaway & B. Ottaway. Bradford, Pp. 132-142.
6. Budd, P. (1991) Eneolithic arsenical copper: heat treatment and the metallographic interpretation of manufacturing processes. A*rchaeometry'90*, ed. E. Pernicka, G.A. Wagner Birkhaüser Verlag, pp. 35-44.
7. Carozza, L., Bourgarit, D. & Mille B. (1999): L'habitat et l'atelier de métallurgiste chalcolithique d'Al Claus: analyse et interpretation des témoins d'activité métallurgique, *Archéologie en Languedoc*, no 21, pp. 147-160.
8. Dran, J.-C., Calligaro, T. & Salomon, J. (2000) – Particle-induced X-ray emission, in *Modern Analytical Methods in Art and Archaeology*, ed. E. CIliberto, G. Spoto & J. Wiley. Chichester, pp. 135-166.
9. Hauptmann, A., Bachmann, H.G. & Maddin, R. (1996) Chalcolithic copper smelting: new evidence from excavations at Feinan/Jordan. *Archaeometry'94*, ed. S. Demirci, A.M. Özer, G.D. Summers. Ankara, pp. 3-10.
10. Mille, B. & Bourgarit, D. (1998) Du Minerai De cuivre sulfuré traité dès le Chalcolithique : les exemples de Cabrières (Hérault) et Al Claus (Tarn-et-Garonne). *Paléométallurgie des cuivres*, dir. M.C. Frère-Sautot, Monographies Instrumentum n° 5, pp. 27-35.
11. Mohen, J.-P. & Walter, P. (1994) Le fourcreuset, une invention inédite de l'Âge du Bronze européen. *Techné*, 1, pp. 103-110.
12. Northover, J.P. (1989) Properties and use of arsenic-copper alloys. *Old world archeometallurgy*, *Proc. Int. Symp. Heidelberg 1987*, ed. A. Hauptmann, E. Pernicka & G.A. Wagner, pp. 111-118.
13. Pollard, A.M., Thomas, R.G. & Williams, P.A. (1989) Some experiments concerning the smelting of arsenical copper. *Archaeological sciences 1989, Proc. of a conf. on the application of the scientific techniques to archaeology*, ed. P. Budd, B. Chapman, C. Jackson, R. Janaway, B. Ottaway. Oxbow monograph 9. Bradford, Pp. 169-174.
14. Rothenberg B. (Ed.) (1990) *The Ancient Metallurgy of copper*, Vol. 2, Institute of Archaeology, London.
15. Tite, M.S., Hughes, M.J., Freestone, I.C., Meeks, N.D. & Bimson, M. (1990) Technological characterisation of refractory ceramics from Timna. *The ancient metallurgy of copper*, ed. B. Rothenberg Institute of Archaeology, London, pp. 158-175.

11.5 The Elemental Analysis of Anthropogenic Soil of Harappan Site of Dholavira

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Before coming to the main results of the analysis I would like to describe here the brief introduction, methodology/ techniques used and aim of the study for your kind knowledge. The authentic references are also included in the last of the report.

11.5.1 Introduction

Based on experience and tradition, study of various types of archaeological artifacts, stratigraphy, geomorphology and paleontology, morphological analysis of faunal and plant remains etc. has been most widely used archaeological prospecting methods to asses the occupational and environmental intensity of ancient animal population since long. However, it has also .been established that human activities such as depositing refuse excrement on soil, building fires and interment of animals and men alter the whole chemistry of natural soil (Arrhenius, 1931, 1955; Treganza and Cook, 1948; Dietz, 1957; Jackson, 1958; Deetz and Dethlefsen, 1963; Black, 1965; Cook, and Heizer, 1965) and finally after natural chemical process, soil forms some compounds of different elemental composition, which holds the characteristic feature of activity (Jackson, 1958; Black, 1965).

Later on, from 1960 onwards soil chemistry came in existence in archaeological science, and a number of archaeologist have examined the intensity of occupation thoroughly by using the phosphate increment in archaeological soil, i.e. Olsen and Dean (1965), Proven (1971), Nunez (1975), Sjoberg (1976), Proudfoot (1976), Eidt (1977), Woods (1977,1984), White (1978), Joshi et al (1978), Joshi and Deotare (1982), Bakkevig, (1980), Conway (1983), Konard, (1983), Stein, (1992), Nautiyal et al (1992), Farswan and Nautiyal (1994) etc. Besides this, some research on the analysis of elements like magnesium, calcium, potassium and carbon content of soil include study of Lutz (1951), Parson (1962), Heidenreich et.

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al. (1971), Heidenreich and Navatril (1973), Heidenreich and Konard (1973), Griffith (1980, 1981) and Lavy (1980). However, there are several other major and minor elements, which are also significantly useful in each area of applied environmental and biotechnological research. After 1970s these elemental studies attracted the attention of archaeologist towards the advancement of applied scientific archaeological research and based on these studies the trace element analysis has become a authentic and useful technique in archaeological science, as these elements (Mg, Ca, Ba, Sr, Fe, Zn, Mn, Na, K etc.) are also helpful to infer various aspects of past occupation. Some studies has already been done on this discipline by Bradley (1980), Eidt (1985), Davies et. al.(1988), Bintliff (1990), and Lunderholm and Lundberg (1994). But after going through the survey of archaeological literary data we have found that the study of trace elements in archaeological soil is not enough in archaeological documentation. Specially research on the chemical analysis of Indian archaeological and Harappan anthropogenic soil is scanty. Therefore, keeping in view of the same we have conducted the present study in the anthropogenic soil of Dholavira, to fill up such a lacuna. We have selected soil as a analytical material because as we know that soil itself is a important and basic part of living activity. The main aim of our study was to estimate the intensity of occupation at different cultural phases of Dholavira civilization with the help of concentration of various trace elements.

11.5.2 Material and Methods

A total of 100 soil samples were collected systematically from each cultural layer of citadel, middle town and lower town during the excavation of Dholavira in 1992. At the same time two sets of controlled soil samples (20 from barren land and 20 from agricultural land) were also collected from outer periphery of site after digging two sections of 1.30 meter respectively. All the soil samples were numbered and packed in airtight polythene bags to protect from external effect. The depth and other associated features of each controlled and archaeological sample was also recorded for the better interpretation, understanding and comparison of results. To see the status of preservation of site (acidity and alkalinity) the hydrogen ion

concentration (pH) of soil was also measured at each location and depth of the site (table.1) through the field pH meter of HANNA (HI 8424). The collected samples were oven dried at 100 degree Celsius for at least 36 hours, after drying each sample was grinned mechanically and passed through a 2 millimeter screen sieve. Then 200 milligram of each sample was weighed into polypropylene vial and 20 milliliter of I-molar hydrochloric acid was added to each vial but each stage of processing it is also necessary to mark the respective number in each vial or test tube. All these samples were kept at room temperature (26 degree Celsius) for two weeks with intermittent agitation (continuous shaking) every day. Later on the resulting solution was filtered separately and trace elements were analyzed through Inductively Coupled Plasma Spectroscopy (I.C.P.) was calibrated against the certified standard before analyzing the sample and a reference sample was also run with each set of samples to verify the data. The results obtained were calculated and correlated statistically to see the pattern of activity of ancient occupation at different phases and location of civilization.

11.5.3 Observations

The analytical results obtained are presented in table- 1, 2, 3 & 4. As it has already been established that the acidic and alkaline nature (pH) of soil alter the preservation status of the archaeological material (Arrhenius, 1931, 1955; Black, 1965; Cook and Heizer, 1965; Bradley, 1980; Davies et al, 1988). Keeping in view the hydrogen ion concentrations of soil at different locations of Dholavira were measured, the mean values of our estimation (Table. 5) show that the horizontal and vertical distribution of pH at various locations of Dholavira are between 6.99 to 7.42. This range of pH is favorable to the better preservation of the archaeological material. It is confirmed from the various artifacts, faunal remains and other associated archaeological material, which were found in well preserved condition after excavation (Bisht, 1993).

As described earlier that along with the Phosphorus, other elements like, Calcium (Ca), Iron (Fe), Sodium (Na), Potassium (K) and Magnesium (Mg) are also

found to be good indicator of the occupational intensity. We have carried out the whole analysis carefully and it is observed that the concentration of all the elements mentioned above are falling in a fashion of gradual enhancement up to the fifth phase of the occupation, indicating a gradual increment in the intensity of occupation. After fifth phase there was a sudden decrease in the concentration of these elements, suggesting the downward activity of the occupation.

While the whole analytical data for all the elements considered shows a rich intensity of occupation at fifth phase, as the highest correlative values of these elements observed under this phase. Though, the results obtained also showing a constant and higher activity during third phase but it is little bit less than phase fifth. In the last phase of the occupation the results also suggesting least activity of Harappan settlement.

Besides this the grayish paste samples from different locations of the site was also taken for the analysis, because this type of paste was used frequently by the Harappan settlers at every locations of the occupation. So these samples were also analyzed through I.C.P. to know the composition of the paste used. The measured values of the elements showing a higher concentration of Calcium in these samples, indicating the mixture of Calcium compounds of lime like substance.

The range of concentration of Ca, P, Mg, Fe, Na, and K at various location of occupation i.e. in Acropolis, Bailey, Middle town and Lower town are significantly higher in comparison to the controlled soil samples of barren land of the same area, which were collected from the outer periphery of the occupation site. In these samples the data shows insignificant values. It is obvious from the concentration of all the elements that the pattern of distribution of all these elements are same in all the locations of civilization except in some cases i.e. middle town (Dumpy material), Acropolis and Bailey (near burials). At these locations (Dumpy materials of middle town and near burial of Acropolis & Bailey) the pattern of distribution of elements is different. We have also analyzed the soil samples collected from the modern

agricultural land (activity area), nearby the study site, which are also showing a significant concentration of all above elements as compared to controlled (from barren land) soil sample and the pattern of distribution is also similar as of archaeological samples. This experiment was performed for the confirmation of the archaeological data.

However, finally I would like to inform you that we were unable to analyze the soil samples of Harappan burial locations of Dholavira as these were not received by us. For the furthermore information kindly note that the detailed study can be done to assess the environment as well as palaeodietary aspects of the occupation through Carbon/Nitrogen isotope and trace element analyses of faunal remains.

11.5.4 Conclusion

As described in the beginning that the purpose of the present research was to demonstrate the significance and utility of trace element analysis in estimating the intensity of ancient occupation. Resulting data from our study clearly indicating that along with the phosphorus, other elements like Ca/Sr, Mg, Fe, Na, K, Ba, Mn Zn etc. can be used as a archaeological tool to locate the activity areas and ecological condition of the past occupation. Besides this it is also suggested that this study is interesting and necessary in the modern occupation of different ecological zones of the universe along with their natural soil, fauna and flora as well, which would not only be beneficial to archaeological documentation but also will be helpful in verifying the archaeological data.

References

1. Arrhenius, O. (1931). Die Bodenanalyse in dienst der Archaeologie. Zeitschrift fur pflan-zenernarhung Dungung and Bodenkunde, *Teil B 10 Jahrgang, pp. 427-439*.

2. Arrhenius, O. (1955). Chemical Denudation in Sweden. *Tellus*: 6(4): 326-341.

3. Bakkevig, S. (1980). Phosphate analysis in archaeology, Problems and recent progress.*Norwegian Archaeological Review*, 13(2): 73-100.

4. Bintliff, J.L., Davies, B.E., Gaffney, C.F. and Waters, A. T. (1990). Trace metal accumulation in soil on and around ancient settlement in Greece. *In (S. Bottema, G. EntjesNieborg and W. Van Zeist, Eds.) Man's Role in Shapil1g of the Eastern Mediterranean Landscape. Rotterdam: Balkema, pp. 159-172.*

5. Bisht, R.S. (1993). *Dholavira: Harappa Sabyata ke Naye Aayam*.

6. Puratattva, Aajkal, pp. 3-12, 35.Black, C.A. (1965). *Soil plant relationships. 2nd Edition*. Willey and Sons, New York.

7. Bradley, R.I. (1980). Trace elements in soils around, dyfed, wales. *Geoderma*, 24: 17-23.

8. Bockheim, J. G. (1980). Properties and classification of some desert soil in course-textured glacial drift in the Arctic and Antarctic. *Geoderma*, 24: 45-69.

9. Conway, J.S. (1983). An investigation of soil phosphorus distribution within occupational deposits from a Romano-British Hut group. *Journal of Archaeological Science*, 10:117-128.

10. Cook, S. E. and Heizer, R. F. (1965). Studies on the chemical analysis of the archaeological sites. *University of California Publications- in Anthropology, 2: 1-102*.

11. Davies, B.E., Bintliff, J.L., Gaffney, C.F. and Waters, A.T. (1988). Trace metal residues in soil as markers of ancient site occupance in Greece*. In (D. D. Henlp hill Ed.) Trace substances in Environmental Health XXII,I988, A symposium. Columbia, MO: University of Missouri, pp. 391-398.*

12. Day, J. H. (1964). Characteristics of soils of the Hazen camparea, northern Ellesmere Island, N. W. T. Operation Hazen, *Defense Research Board (Ottawa), Hazen,* 24:15.

13. Deetz, J. and Dethlefsen, E. (1963). Soil pH as tool in archaeological interpretation. *American Antiquity*, 29(2): 242-243.

14. Deotare, B. C. (1990). Chemical study of anthropic soils from Chalcolithic Tuljapur Garhi. *Man and Environment*, XV(2): 61-62

15. Dietz, E. F. (1957). Phosphorus accumulation in soil of an Indian habitation site. *American Antiquity*. 22(4): 405-409.

16. Eidt, R.C. (1973). A rapid chemical field test for archaeological site surveying. *American Antiquity*. 38(2): 206-210.

17. Eidt, R. C. (1977). Detection and examination of anthrosols by phosphate analysis. *Science*, 197: 1327-1333.

18. Everett, K. R. (1971). Soils of the Merserve glacier area, Wright valley, South Victoria Land. *Antarctica Soil Science*, 112, 425-438.

19. Farswan, Y. S. and Nautiyal, Vinod (1994). Investigation of phosphorus enrichment in the burial of Kumaun (mid-Central) Himalaya, India. *Journal of Archaeological Science* (Accepted for Publication).

20. Griffith, M. A. (1980). A pedological investigation of an archaeological site in Ontario. I. An examination of soils in and adjacent to a former village. *Geoderma*,24: 327-336.

21. Griffith, M. A. (1981). A pedological investigation of anarchaeological site in Ontario. II. Use of chemical data to discriminate features of the Benson site. *Geoderma*, 25: 27-34.

22. Heidenreich, C. E. and Navratil. S. (1973). Soil analysis at the Robitaille site. 1- Determining the parameter of the village. *Ontario Archaeology*,20: 25-32.

23. Heidenreich, C.E. and Konard, V.A. (1973). Soil analysis at the Robitaille Part-II: A method useful in determining the location of Longhouse patterns. *Ontario Archaeology*, 21: 33-62.

24. Heidenreich, C.E., Hill, A.R., Lapp, D.M. and Navatril, S (1971). Soil and environmental analysis at the Robitaille site. *In (W. M. Hurley and C. E. Heidenreich Eds.) Palaeoecology and Ontario Prehistory. University of Toronto Research Report No. 2, pp. 179-237.*

25. Jackson, M. L. (1958). Soil Chemica/Analysis. Prentice Hall, Englewood Cliffs, N. J. USA. Joshi, R. V., Mujumdar, G.G. and Deotare, B.C. (1978). Phosphate analysis and archaeology a note. *Man and Environment*, II: 72-73.

26. Joshi, R. V. and Deotare, B. C. (1982). Phosphate analysis of some archaeological site in Madhya Pradesh. In *Indian Archaeology* (R. K. Sharma Eds.) pp. 195-202.

27. Konard, V. A. Robson, Bonnichsen and V ickie Clay (199-83). Soil chemical identification of ten thousand years of prehistoric activity areas at the Munsungun Lake Thoroughfare, Maine. *Journal of Archaeological Science*, 10: 13-28.

28. Lavy, Rachel (1980). Sources of soluble calcium & Magnesium and their effects on sodium adsorption ratios of solutions in two soils of Israel. *Geoderma*, 23: 113-123.

29. Lutz, H.J. (1951). The concentration of certain chemical elements in the soils of Alaskan archaeological sites. *American Journal of Science*, 249, 925-928.

30. Nautiyal, Vinod, Farswan, Y.S. and Rawat, J.S. (1992). Phosphorous analysis of soil form archaeological sites in the mid-Central Himalayan and Ganga-Yamuna Doab. *Man and Environment*, XVII(I): 41-50.

31. Nunez, M. (1975). Phosphorus determination of the graves of the Kilteri in Vantaa, Southern Finland. *Expainas Suomen Museo*: 18-25.

32. Olsen, S. R. and Dean, L. A. (1965). Phosphorus. In: Black, C. A. *et al* editions, Methods of soil analysis. *Am. Soc. Agron*., Monograph, 9: 1035-1049.

33. Proudfoot, N. (1976). The analysis and interpretation of soil phosphorus in archaeological contents. In *Geoarchaeology* (D. A. Davidson and M.A. Shackley Eds.) Duckworth, London, pp. 93-113.

34. Proven, D. (1971). Soil phosphate analysis as a Tool in archaeology. *Norwegian Archaeology Review*, 4(1): 37-50.

35. Parsons, R. B., Sholtes, W. H. and Reicken, F. F. (1962). Soil of Indian mounds in north east Iowa as benchmarks for studies of soil genesis. *Soil Sci. Am., Proc., 491-496.*

36. Sjoberg, A. (1976). Phosphate analysis of anthropic soils. Jol/mal of f~ield Archaeology, 3: 447-454.Stein J. K. (1992). Sediment analysis of British camp Shell Midden. *In (J.K.Stein Eds.) Deciphering a Shell Midden, Diego, Academic Press, pp. 135-162.*

37. Tedrow, J. C. F. (1970). *Soil investigations in Inglefield Land*. Greenland Medd. Groenl., 188(3): 93.

38. Treganza, A. E. and S. F. Cook (1948). The quantitative investigation of Aboriginal sites: Complete excavation with physical and archaeological analysis of a single mound. *American Antiquity*, 13: 187-197

39. White, E. M. (1978). Cautionary note on soil phosphate data interpretation for archaeology. *American Antiquity*, 43(3): 507-508.

40. Woods, W. I. (1977). The quantitative analysis of soil phosphate. *American Antiquity*, 42(2):248-252.

41. Woods, W. I. (1984). Soil chemical investigation in Illinois archaeology: Two example studies. In (J. Lambert Ed.) *Archaeological Chemistry-III*. American Chemical Society, Washington DC, pp. 67-77.

11.6 Analysis of Faunal Remains from the Excavations at Dholavira (District Kutch, Gujarat)

Ajita Patel

11.6.1 Introduction

Since 1989, excavations have been carried out by the Archaeological Survey of India at the site of Dholavira (District Kutch, Gujarat) under the direction of R.S. Bisht. During this period, enormous quantities of faunal remains comprising animal bones and teeth as well as mollusks have been recovered. In 1995 the Archaeological Survey of India granted me permission to carry out zooarchaeological study at the site. The first task facing me was to decide where to begin the analysis of such a sheer mass of material. It was necessary to establish priorities and goals for the analysis. Of primary importance was to select faunal assemblages that would provide a good understanding of animal exploitation patterns both through time and across the city.

During the five campaigns of excavation at Dholavira, large scale clearings were made in a series of trenches across the site as well as in deep diggings in each of the three principal sectors of the city designated as the Citadel (comprising the "Castle" and "Bailey"), the Middle Town, and the Lower Town. Deep soundings on the Citadel have revealed the history of the construction, fluorescence, and decline of the city over the course of the third and into the second millennium B.C.. Seven cultural stages (I-VII) have been recognized by the excavator that encompass the periods known as the Early, Mature, and Late Harappan (Bisht 1989a, 1989b, 1989/90, 1994a, 1994b).

The various sectors of Dholavira were probably inhabited by different societal groups. They are likely to have had differential access to animal products such as meat and milk, which should be reflected in the faunal remains. For example, there may be more wild animal bones in one area, more cattle and water buffalo in another, more sheep and goat in a third. Different cuts of meat may end up in different sectors as well, depending on the ability of a particular group or household

to obtain choice portions of the carcass. Such access may also change with time. In order to identify such patterns, we need to compare faunal assemblages from different sectors and from different periods.

11.6.2 The Contexts

In carrying out a comparison of assemblages between sectors of the city, we also need to consider the nature of the contexts being compared. The processes involved in the formation of these deposits are sometimes not completely evident. Masses of trash can be deposited and redeposited as areas fall into disuse and then are cleared, levelled, and rebuilt. Particularly common types of deposits include those in and on floors of rooms, those in streets and alleys, and those in upper room fill, dumps, and pits. Bones found in primary deposits such as in and on room floors comprise pieces that were not removed by the former inhabitants during house-cleaning operations. Those pieces that were removed by such cleaning would often have been thrown into adjacent streets and alleys. Such secondary deposits in streets can be expected to directly represent the disposal activities of the people living in the adjacent structural units and to provide a direct record of the butchery and consumption activities of those people. It is for these reasons that I decided to focus my first analyses on street deposits.

Although trash dumped in the streets of Dholavira may have been removed periodically, excavation suggests that in many cases it was merely packed into a new surface by maintenance activities or by day to day traffic. For example, from a deep sounding in the Middle Town, there were 25 distinct street surfaces identified in a depth of about six and one half meters with no fill and only a very few identifiable erosional deposits. This shows that the zone was constantly in use as a street and as such provides a particularly valuable stratigraphic sequence of archaeological remains. A similar deposit was encountered in the Bailey the bones from which are here compared with those from the deep sounding in Middle Town.

The Bailey deposits analyzed cover some of Stage III, all of Stage IV, and some of Stage V. Those in the Middle Town are confined to Stages III and IV only.

Stages III and IV represent the full florescence of the city in the Mature Harappan phase, while Stage V is in the following period of decline (R.S. Bisht, personal communication). During Stage III in particular, the city was meticulously maintained as the deposits are even and show no pits; and in some areas there were multiple recoatings of both walls and surfaces with different shades of pink plaster.

11.6.3 Materials

The following mammalian remains were studied and recorded:

Sector	GSQ	Layers	# of fragments
Bailey	57 x 57 x 2	4 --22	3399
Middle Town	45 x 43 x 2	11 --48	5597

Additionally there are the remains of birds, fish, and mollusks which are not included in the counts above. All specimens were collected by screening the sediment where possible and by hand-picking those deposits that were too clayey to screen. This ensured relatively good recovery of material. The students of the Institute of Archaeology were of great assistance in ensuring both good recovery of the material and in providing details of the nature of the deposits being excavated every day.

Upon recovery, specimens were placed in cloth bags and labels attached. The use of cloth bags permitted damp specimens to dry slowly, thus inhibiting splitting and preventing the growth of mildew. Upon arrival in the excavation camp, the specimens were cleaned and labelled.

11.6.4 Methods

Those bags of bones selected for analysis were sorted according to Class (Mammal, Bird, Fish, Mollusk, etc.). For mammals, the bones and teeth were further sorted by skeletal part and animal size. Details about the specimens were recorded on computer coding sheets using a format modified from Meadow (1978). The

following attributes were recorded, where possible, for each specimen or group of like specimens:

Site and Locus
Bone #
Articulation (whether specimens join)
Element
Taxon
State of Domestication
Certainty of Identification
Symmetry (Right or Left or Center)
Sex (pelvis, antler, teeth or other dimorphic indicator)
Estimated Age at Death
Size of Animal
Evidence of Disease
Evidence of Burning
Bone Modification (polish, cut mark, tool, etc.)
Fragmentation (modern or ancient breakage)
No. of Pieces
No. of Elements (for standardized count)
Weight in grams
Fragment Size (in relation to original size of bone)
Skeletal Part (end -proximal or distal, etc.)
State of Fusion
Location of Cut Marks
Tooth Type
Tooth Class
Tooth Position
Tooth Root
Tooth Wear

Measurements were taken on complete or partially complete specimens following the protocol of von den Driesch (1976) supplemented by the work of other investigators (Stampfli 1963; Speth 1983; Meadow, personal communication).

Once these features were recorded, the data were entered into a computer spreadsheet. These data were summarized and tabulated, and charts and graphs were generated using Microsoft Excel for the Macintosh (Version 4.0).

11.6.5 The Results

11.6.5.1 Taxonomic representation

The following taxa were identified in the collections analyzed:

Table 1: Taxa identified from Dholavira 1995

Mammalia	**mammals**
Bovidae	cattle family
Bos indicus	zebu
Bubalus bubalis	water buffalo
?Boselaphus tragocamelus	nilgai (possible ill)
Ovis aries	domestic sheep
Capra hircus	domestic goat
Antilope cervicapra	Blackbuck
Gazella bennetti	gazelle
Cervida	deer family
Axis axis	chital deer
Cervus sp.	large deer
Suidae	pig family
Sus scrofa	boar /pig
Equidae	Equids
Equus hemionus	khur (wild half-ass)
Canidae	dog/fox family
Canis sp.	dog / wolf / jackal
Felidae	cat family
Felis sp.	cat
Leporidae	rabbit family
Lepus sp.	hare
Rodentia	rodents
Aves	**birds**
Gallus sp.	chicken / jungle fowl
Pisces	**fish**
Siluridae	catfish

Crustacea	**crab**
Mollusca	**not identified mollusks**

11.6.5.2 Taxonomic abundances

The assemblages are dominated by the remains of domestic animals especially cows and bulls and water buffalo (the bovines: Bos andBubalusl, sheep (Ovis), and goats (Capra). There is a considerable amount of pig (Sus) represented as well, but it is not yet clear whether this was domestic or wild. And there are a few dog or jackal bones (Canis). Among the wild mammals, remains of gazelle (Gazella), blackbuck (Antilope) , deer (cervids) , wild ass (Equus hemionus) , and hare (Lepus) have been identified. The bones of birds, fish, and rodents, have all been documented in small numbers, but they are not represented in Figures 1 and 2 (based on Table 2) which present the proportions of mammalian taxa for the Bailey and Middle Town.

Particularly dominant in the Middle Town deposits are bovine remains which make up 74 percent of the assemblage of identified bones (Figure 2 and Table 2). This contrasts with only 51 percent in the Bailey, where the remains of pig and all small bovids are more common (Figure 1 and Table 2). These pattems are confirmed when one looks at the distributions of all bones from the two areas including those identified and those not assigned to a specific taxon (Figure 3 and Table 2). Thus the percentage of large mammal in the Middle Town is 73 and in the Bailey 58. These overall percentages, however, mask differences between the periods, particularly in the Bailey.

Wild animal bones including those of hare, equid, antilope, and gazelle are more common in Stage III than in later periods in the Bailey (Figure 1). In Stage IV, bovine bones are reduced in number, making up about 40 percent of the assemblage, with the remains of sheep, goats, and pigs being relatively numerous. Stage V reverts to the situation in Stage III, but with only a few wild animal remains and a correspondingly higher percentage of bovine bones. These patterns once again are confirmed when bones not assigned to taxon are considered (Figure 3).

In contrast to the Bailey, the faunal assemblages of the Middle Town are remarkably uniform, with very little difference in the proportions of medium to large mammal bones in Stages III and IV (Figure 3). The overwhelming dominance of bovine remains in the street deposits of this part of the city is remarkable (Figure 2).

Looking at the ratios of closely related forms, there is considerable consistency between the Bailey and Middle Town in the proportion of sheep to goats (Figures 1 and 2 and Table 2). In both areas the two forms are equally represented in Stage III and there are more sheep than goats in Stage IV. In Stage V, which is represented by analyzed fauna only from the Bailey, goats remains outnumber those of sheep. These proportions, however, especially for Stage III are based on quite small samples of bones identifiable to genus and thus more material is needed to substantiate these patterns.

Differences in the sheep-goat ratio are often used by zooarchaeologists to show the interplay of environmental constraints and cultural choices (Redding 1984). Goats tend to do better in harsher environments than do sheep, but sheep provide the wool that goats do not. The relatively even sheep-goat ratios at Dholavira are similar to those in contemporary levels of Nausharo, located in arid eastern Baluchistan. This contrasts to the situation at Harappa, located in a better watered part of the Punjab, where sheep overwhelmingly dominate the Harappan period small bovid assemblages and where goat remains are quite rare (Meadow 1991). Such a difference may reflect the harsher environmental conditions in Kutch and Baluchistan that are more suited to goats. Yet significant numbers of sheep were kept at both Nausharo and Dholavira, suggesting the cultural importance of these animals. Measurements of the sheep bones from all three sites also indicate the significance of environment. Breadth and depth dimensions of Dholavira and Nausharo sheep bones show that the animals were relatively light in weight (Figure 4 and Meadow 1991: Figure 7.6). This is different from Harappa where the sheep

were much heavier, perhaps even suggesting the presence of a different breed (Meadow 1989, 1991: Figure 7.5).

I now tum to the relative proportions of Bos and Bubalus remains (Figure 1 and 2 and Table 2). The bones of these two morphologically similar forms have been differentiated on a preliminary basis using characters currently being worked out on modem specimens. In the Bailey, cattle bones outnumber those identified as water buffalo by more than three to one in both Stages III and N during the period of urban florescence, with the reverse being true in Stage V at which time the function of the Bailey may have changed. In the Middle Town, water buffalo bones are relatively rare in Stage III but much more common in Stage N.

Differences between the Bailey and Middle Town are also reflected in the taxonomic representations as a whole. The situation in the Bailey is more variable than it is in the Middle Town. In the Bailey wild animals and caprines are better represented overall than they are in the Middle Town where bovines overwhelmingly dominate all assemblages. These differences between two sectors of the same cityduring full florescence in the Mature Harappan phase (Stages III and IV) thus cannot reflect herd composition based on environmental constraints, but represent choices made about what kind of meat to consume. Of particular interest in this respect is the high proportion of wild fauna represented in the Bailey in Stage III and of small bovids and pigs in Stage IV. This indicates greater access to what could have been choicer foods in the Bailey and may reflect a socio-economic difference between the inhabitants of these two sectors of Dholavira.

11.6.6 Equids

Of importance in the analysis of faunal remains from Dholavira is the identification and characterization of equids. Owing to its location in the Great Rann of Kutch, Dholavira lies within the range of the natural habitat of Equus hemionus (khurf wild half-ass). Seven equid specimens were identified and recorded: one from the Middle Town and six from the Bailey. All except one specimen are too small to be from domestic horse and are most likely from khur (complete set of upper

maxillary teeth, distal tibia, talus, femur shaft, fourth metatarsal, and central tarsal). One right upper fourth premolar is large (occlusal length = 28.4 mm) with protocone index of 50 (protocone length = 14.2). This tooth
is comparable in size and morphology to the relatively large equid teeth from Surkotada that Sandor Bokonyi (in press) has identified as coming from true horse. In a review of Bokonyi's study, however, Meadow and Patel (in press) have questioned these identifications, noting that some male khur are also very large -- equal in size to some horses.

Concerning the morphology of the enamel folds on the occlusal surface of the tooth, the Dholavira specimen has a small fold in the peninsula of enamel on the lingual side of the tooth. A particular form of this kind of fold --the "pli caballin" --is characteristic of true horses. On the Surkotada and Dholavira specimens, however, the fold is different in shape from that typical of the horse. Instead of intruding lingually into the peninsula from its buccal margin as in true horses, it protrudes distally into the peninsula from the mesial side. In addition, there is a distinct projection of enamel pointing towards the center of the tooth from the peninsula. Based on a few comparative specimens from the Rann, this seems to be a khur and not a horse trait, although the feature needs to be checked on a large sample of equid material.

Collection of just such a large sample of modem equid bones is currently underway. The purpose of this collection is to document features of size and morphology of khur, horse, and donkey in order to distinguish in a consistent and reliable fashion between these osteologically similar equid forms.

11.6.7 Kill-off Patterns

Animal mortality or "kill-off' patterns lend support to some of the above observations about differences between the Bailey and Middle Town. These patterns basically represent the survivorship of animals beyond a particular age-stage. This survivorship information permits definition of kill-off patterns reflecting different husbandry strategies. Such strategies may comprise a principle focus on primary

products (meat, hides, and other products of the dead animal) or on secondary products (traction, milk, and other products of the living animal), or they may involve mixed husbandry goals (Payne 1973; Watson 1978).

Tables 3 and 4 present data on epiphyseal union for the Bailey and Middle Town. Figure 5, based on these data, shows survivorship "curves" for bovines (cattle and water buffalo), caprines (sheep and goats), apd suines (pigs). Age-stage I is the youngest age bracket. This represents the end of the infant stage at which time separate growth centers in the scapula and pelvis are fusing. At the other extreme, age- stage VI in bovines and caprines and age-stage III in suines is the oldest age bracket definable by epiphyseal union. This represents the last stage as the animals become skeletally mature and growth is largely completed (at c. 4 yrs in cattle and 3.5 years in caprines and pigs: Silver 1969; Habermehl 1975).

In both the Bailey and Middle Town the pattem of kill-off for boVines is similar. Almost all animals survive age-stage III, some are killed off before age-stage IV (the time at which growth is slowing down), and the rest mostly survive into full adulthood (beyond age-stage VI). This is a pattem consistent with the use of animals for traction (e.g., plowing, hauling, and transport) as opposed to use for meat in which case one would expect higher kill-off in the younger age-stages.

For the caprines and suines, however, mortality pattems in the Bailey and Middle Town differ. Under 60 percent of the pig bones from the Bailey that fuse in age-stage I have joined epiphyses. This indicates significant kill-off of infant animals in contrast to the situation in the Middle Town where kill-off appears to have been later, during the juvenile phase (between age-stages I and II). Mter that, the animalsappear to have survived into full adulthood. These results, however, are based on only 29 pig bones from the Middle Town and 24 from the Bailey (Tables 4 and 3, respectively), which is not enough to make a definitive judgment. Small sample sizes lead to great variability in the skeletal parts represented and thus in the configuration of survivorship curves.

We also do not know whether the pigs at Dholavira were wild or domestic, although the relatively high survivorship through the oldest age-stage would indicate that they were hunted. With domestic pigs one does not have to keep animals alive into adulthood in order to ensure maintenance of the population because pigs are fecund and reproduction can begin in the first year of life.

In the case of caprines also, kill-off in the Bailey appears to have taken place earlier than in the Middle Town. By age-stage II, survivorship in the Bailey was 80 percent while it remained at nearly 100 percent in the Middle Town. Between age-stages II and III, kill-off is quite similar in the two areas. The anomalously low value for age-stage IV in the Middle Town can probably be accounted for by the very small sample of six bones for that group (Table 4). In both areas survivorship is more than 40 percent through the last age-stage. This survivorship indicates maintenance of breeding stock, particularly females, well into adulthood. Older caprines could also have been used during life for secondary products such as milk and especially wool and hair. The early kill-off in the Bailey could be due to a demand for meat from younger animals. This would indicate differential access to animals in the two areas and confmn what is suggested by the taxonomic abundance data.

11.6.8 Animal Size

Another feature of the Dholavira fauna that is being studied is animal size and body proportions as reflected in skeletal dimensions. The aims of such analysis are to assist in the differentiation of morphologically similar taxa, to help identify different breeding populations both within sites and between regions, and, in highly dimorphic forms, to provide information on differential exploitation of the two sexes. As a first step in such analysis, the size (height) of water buffalo and cattle have been documented on the basis of length measurements of the first and second phalanges. When present, these skeletal parts are generally complete or nearly so and can be identified to taxon with some degree of reliability (following Higham 1975; Meadow 1981).

In Figure 6 the greatest peripheral length of first phalanges (GLpe) and the greatest length of second phalanges (GL) from Dholavira are compared to analogous "standard" dimensions from a single zebu (measurement definitions in von den Driesch 1976). The standard measurements used are 68.9 mm for the first phalanx and the 44.6 rnrn for the second phalanx (from Meadow 1991: Table 7.1). Comparison is carried out by subtracting the log (base 10) of the standard dimension from the log of the dimension of the archaeological specimen. The resulting log differences for the two bones (first and second phalanx), thus scaled to the same axis, are plotted (Figure 6). Bones larger than the standard are above the "0" line and those smaller are below that line (Meadow 1981).

The results suggest that Dholavira had a full range of water buffalo from quite small to very large. This may indicate the presence of more than a single population or different breeds specifically raised for different purposes. These are only very tentative hypotheses, however, which in order to be validated require much further study of the buffalo remains.

In contrast to water buffalo, size variability in cattle is less, with no very large or very small animals represented. Comparing the results for cattle with those from Nausharo and Harappa (Meadow 1991: Figure 7.4), it is evident that the cattle from Dholavira are more similar in height to those from Nausharo. This supports what was noted earlier about the arid environments of eastem Baluchistan and Kutch which are suited to the extensive herding of goats and cattle. Kept under such harsh conditions animals tend to be smaller. Yet the people of Dholavira also chose to keep water buffalo, an animal with high water requirements --an issue further developed in the conclusion.

11.5.9 Skeletal part distributions

The study of skeletal part distributions is used to evaluate taphonomic processes (how depositional and post –depositional processes affect bones) as well

as to compare butchery pattems and consumption between different sectors of a site. The data, presented in Table 5 can be graphed as in Figures 7 and 8 where the percentages (on the y-axis) are the proportions of the various skeletal parts (along the x- axis). The bones are ordered by time of epiphyseal union from earliest fusing (on the left of the figures) to latest. The expected percentage for each skeletal part in a living animal is 6.25% (100% divided by 16 skeletal parts). In this case the bovid has been chosen to calculate the expected percentage as this group of animals overwhelmingly dominates the faunal assemblages at the site.

Only a few skeletal parts are at the expected level of 6.25% (e.g., Figure 7 and Table 5: Large Mammal: BL+MT distal scapula, BL+MT distal humerus, MT distal Mc 111+ IV, MT calcaneum, and BL proximal ulna). Most are either "over-" or "under-" represented, with there being variability in representation between the Bailey and Middle Town as well as between Medium and Large Mammal. Particularly badly under-represented are phalanges, especially of Medium Mammals. This might reflect problems related to both preservation and recovery.

Generally speaking (with the exception of phalanges) late fusing skeletal parts are less well represented than are earlier fusing ones because they are composed of more spongy bone that is more easily affected by destructive agents. This situation affects the construction of survivorship curves, particularly for the later age stages.

Differences between the Bailey and Middle Town in skeletal part representation (Figures 7 and 8) are not marked. This may change, however, as greater numbers of samples are analyzed. Factors that might be reflected include selection of certain skeletal parts for industrial purposes and dominance of more meat rich bones in one sector as opposed to another. As an example, the greater numbers of Large Mammal distal metapodials in the Bailey (Figure 7) might be because they were being collected for a specific purpose. Among the bones most commonly used for tool manufacture are Large Mammal metapodials.

11.6.10 Comparative Collection

Another aspect of the zooarchaeological work carried out at Dholavira has been the accumulation of a comparative collection of modem animal skeletons. Such collections are essential to the identification and characterization of the ancient remains. Distinguishing between the different forms of the large bovids (water buffalo, cattle, nilgai) , medium bovids (goat, sheep, blackbuck, gazelle), deer (chital, hog deer, sambar, barasingha) , and equids (khur, donkey, horse) requires careful comparative osteological analysis. Such work needs to be based on the study of a number of individuals of each taxon because of great population variability especially within the domestic species. For example, the modem water buffalo and cattle remains that are being collected are being documented in the same fashion as the ancient bones in order to identify the presence of specific breeds in the ancient animal population of Dholavira and to determine if there have been changes in morphology through time.

The comparative collection is assembled from dead animals gathered from the area around Dholavira. The carcasses are boiled in water and sodium perborate to degrease and bleach the bones. The amount of such cleaning depends on the condition of the carcass and size of the animal. Following cleaning, the bones are dried and labelled.

11.6.11 Conclusion

The investigations reported here are only the beginning of a long term study of the Dholavira fauna. Large assemblages from different parts of the site need to be examined in order to securely document faunal variability through time and space. Analysis of kill-off based on pattems of tooth eruption and wear, compilation of data on sex, and study of skeletal part distributions from a larger corpus of material may indicate if there are differences in butchery and consumption activities through time or between areas of the site. The distribution of remains from wild fauna also needs to be investigated in more detail. Fish, birds, wild mammals, and mollusks may have

been supplied by specific segments of the community to consumers living in different areas of the city. Differential distribution of subsistence resources is part of the larger question of provisioning and the relationships between producers and consumers in the pre-:industrial urban context (Zeder 1991).

The animal economy of Dholavira was mostly pastoral in nature involving the use of four principle domestic animals. Although sheep, goat, and cattle can be herded extensively and moved to new grazing areas as needed, water buffalo are dependent on better quality forage and water for soaking their hides. Thus they are likely to have been kept in the city itself where the reservoirs of Dholavira would have provided a reliable source of water for daily bathing. While it is possible that some of the sheep, goat, and cattle needed for provisioning the city could have been obtained from more mobile pastoral populations outside of the city in exchange for agricultural products or other goods, such a situation seems unlikely for water buffalo. Ideas such as these need to be systematically investigated by integrating faunal data with the results of architectural and artifactual studies. Individual kin groups or even households may have included both pastoral and agricultural elements, thus ensuring access to both animal and plant products. In addition, a particular interesting study would be investigation of the relationship of Dholavira with its hinterland. A large city like Dholavira would not have existed in isolation from surrounding communities, whether these be agricultural, pastoral, or even hunter-gatherer.

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Bibliography

1. Bisht, R.S. 1989a. The Harappan colonization of the Kutch: an ergonomic study with reference to Dholavira and Surkotada, pp. 265-272, in *History and Art*, Krishna Deva, Lallanji Gopal, and Bhagwan Singh, eds., Ramanand Vidhya Bhavan, Delhi.

2. Bisht, R.S. 1989b. A new model of the Harappan town planning as revealed at Dholavira in Kutch: a surface study of its plan and architecture, pp. 397-408, in *History and Archaeology*, B. Chattemjee, ed., Ramanand Vidhya Bhavan, Delhi.

3. Bisht, R.S. 1989/90. Dholavira: new horizons of the Indus Civilization. *Puratattva* 20: 71-87.

4. Bisht, R.S. 1994a. Secrets of the water fort. *Down to Earth*, 15 May 1994, pp. 25-31.

5. Bisht, R.S. 1994b. Excavation at Dholavira, District Kutch. *Indian Archaeology 1989-1990*: A Review, pp. 15-20.

6. Bokonyi, S., in press. Horse Remains from Surkotada*. Harappan Studies* 2.

7. Habermehl, K.-H. 1975 Die Altersbestimmung bei Haus-und Labortieren, Verlag Paul Parey, Berlin and Hamburg. Higham, C.F.W. 1975. Aspects of economy and ritual in prehistoric northeast Thailand. *Journal of Archaeological Science*, 2(4): 245-287.

8. Meadow, R.H. 1978 "Bonecode" -a system of numerical coding for faunal data from Middle Eastern sites, pp. 169-186, in Approaches to *Faunal Analysis in the Middle East*, R.H. Meadow and M.A. Zeder, eds., Peabody Museum Bulletin 2, Peabody Museum, Harvard University, Cambridge, Massachusetts.

9. Meadow, R.H. 1981. Early animal domestication in South Asia: a first report of the faunal remains from Mehrgarh, Pakistan, pp. 143- 179, in *South Asian Archaeology* 1979, H. Hartel, ed., Dietrich Reimer Verlag, Berlin.

10. Meadow, R.H. 1989. Continuity and change in the Greater Indus Valley: the palaeoethnobotanical and zooarchaeological evidence, pp. 61- 74, in *Old Problems and New Perspectives in the Archaeology of South Asia*, J .M. Kenoyer, ed., Wisconsin Archaeological Reports 2, Madison, Wisconsin.

11. Meadow, R.H. 1991. Faunal remains and urbanism at Harappa, pp. 89- 106, in Harappa Excavations 1986-1990: a *Multidisciplinary Approach to Third Millennium Urbanism*, R.H. Meadow, ed., Prehistory Press, Madison, Wisconsin.

12. Meadow, R.H. and A. Patel, in press. A comment on "Horse Remains from Surkotada" by Sandor Bokonyi. *Harappan Studies* 2.

13. Payne, S. 1973. Kill-off pattern in sheep and goats: the mandibles from Asvan kale*. Anatolian Studies* 23: 281-303.

14. Redding, R. W. 1984. Theoretical determinants of a herder's decisions: modeling variation in the sheep/goat ratio, pp. 223-241 in *Animals and Archaeology: 3. Early Herders and their Flocks*, J. Clutton- Brock and C. Grigson, eds., BAR Intemational Series 202, British Archaeological Reports, Oxford.

15. Stampfli, H.R. 1963. 18. Wisent, Bison bonasus (Linne) 1758, Ur, Bos primigenius Bojanus, 1827, und Hausrind, Bos taurus (Linne), 1758, pp. 117-

196, in *Seeberg Burgdschisee-sud*, Tea 5: Die Tierreste, J. Boessneck, J. P. Jequier and H. P. Stampfli, eds., Acta Bemensia, vol. 2. Verlag Stampfli, Bem.

16. Speth, J.D. 1983. *Bison Kills and Bone Counts*, University of Chicago Press, Chicago.

17. Silver, I.A. 1969. The ageing of domestic animals, pp. 283-302, in *Science in Archaeology*, second edition, D. Brothwell and E. Higgs, eds., Thames and Hudson, London.

18. von den Driesch, A. 1976. *A Guide to the Measurement of Animal Bones from Archaeological Sites*, Peabody Museum Bulletin 1, Peabody Museum, Harvard University, Cambridge, Massachusetts.

19. Watson, J.P.N. 1978. The interpretation of epiphyseal fusion data, pp. 97-101, in *Research Problems in Zooarchaeology*, D.R. Brothwell, K.D. Thomas, and J. Clutton-Brock, eds. Occasional Publication No. 3, Institute of Archaeology, University of London.

20. Zeder, M.A. 1991. *Feeding Cities: Specialized Animal Economy in the Ancient Near East*, Smithsonian Institution Press, Washington D.C.

Figure Captions

Figure 1: Proportions of different mammalian taxa represented in the identified bones from street deposits of the Bailey for Stages III, IV, and V.

Figure 2: Proportions of different mammalian taxa represented in the identified bones from street deposits of the Middle Town for Stages III and IV.

Figure 3: Proportions of mammalian size classes represented in the total bone assemblages from street deposits of the Bailey and Middle Town.

Figure 4: Difference of logarithms diagram for sheep (Ovis) and goat (Capra) from street deposits in the Bailey and Middle Town combined showing distribution of individual measurements in relation to those from standard animals.

Figure 5: Survivorship curves for cattle and water buffalo (bovine), sheep and goats (caprine) and pigs (suine) from the Bailey and Middle Town, all periods combined.

Stages I-VI for bovines and caprines and I-III for suines are age-stages calculated from epiphyseal union data.

Figure 6: Difference of logarithms diagram for cattle (Bos) and water buffalo (Bubalus) first and second phalanges from street deposits in the Bailey and Middle Town combined showing distribution of individual length measurements in relation to the standard.

Figure 7: Percentage representation of large mammal skeletal parts from the Bailey and Middle Town arrayed in order of epiphyseal union. Figure 8: Percentage representation of medium mammal skeletal parts from the Bailey and Middle Town arrayed in order of epiphyseal union.

Table 2: Mammalian Fauna from Dholavira 1995				
	Bailey Total (n=3399)	III (n=382)	IV (n=1798)	V (n=1219)
small mammal	25	11	8	6
medium mammal	1229	109	744	376
med/large mammal	152	0	93	59
large mammal	1973	260	947	766
very large mammal	20	2	6	12
Total	3399	382	1798	1219
	Bailey Total (n=717)	III (n=104)	IV (n=367)	V (n=246)
Ovis	96	7	69	21
Capra	83	7	50	25
Antilope/Gazella	18	7	8	3
Small Bovid	49	8	28	13
Cervid	5	0	4	1
Canid	3	1	1	1
Sus	75	8	51	16
Bos	33	8	17	8
Bubalus	18	2	3	13
Bovine	317	46	128	143
Equid	6	4	2	0
Lagomorph	14	6	6	2
Total	717	104	367	246
	Middle Town (n=5597)	III (n=1098)	IV (n=4499)	
small mammal	9	4	5	
medium mammal	1080	243	837	
med/large mammal	341	6	335	
large mammal	4109	841	3268	
very large mammal	58	4	54	
Total	5597	1098	4499	
	Middle Town (n=1140)	III (n=234)	IV (n=906)	
Ovis	108	16	90	
Capra	82	16	68	
Antilope/Gazella	9	6	3	
Small Bovid	6	3	3	
Cervid	13	0	13	
Canid	1	0	1	
Sus	76	21	55	
Bos	81	13	68	
Bubalus	72	5	67	
Bovine	689	152	537	
Equid	1	1	0	
Lagomorph	2	1	1	
Total	1140	234	906	

Table 3: Dholavira 1995: Epiphyseal Union Data						
	for the Bailey (all levels combined)					
Bovine -- Bailey					grouped	Age-
	Fused	E-Line	Unfused	%Fused	%Fused	Stage
Scapula, ds	13	0	2	86.7%		
Acetabulum	15	0	1	93.8%	90.3%	I
Radius, px	16	0	0	100.0%		
Humerus, ds	10	0	0	100.0%	100.0%	II
Phalanx 2	12	0	0	100.0%		
Phalanx 1	12	0	0	100.0%	100.0%	III
Tibia, ds	9	1	0	100.0%		
Mc III+IV, ds	1	1	1	66.7%		
Mt III+IV, ds	3	0	1	75.0%		
Mp III+IV, ds	5	0	4	55.6%	76.9%	IV
Calcaneum	7	1	1	88.9%		
Femur, px	6	0	4	60.0%	73.7%	V
Tibia, px	7	0	3	70.0%		
Femur, ds	4	0	1	80.0%		
Ulna, px	9	0	1	90.0%		
Radius, ds	6	0	1	85.7%		
Humerus, px	2	0	0	100.0%	82.4%	VI
	137	3	20	87.5%		
Caprine -- Bailey						
	Fused	E-Line	Unfused	%Fused	%Fused	
Scapula, ds	10	0	3	76.9%		
Acetabulum	11	0	0	100.0%	87.5%	I
Radius, px	10	0	2	83.3%		
Humerus, ds	6	0	2	75.0%	80.0%	II
Phalanx 2	2	0	0	100.0%		
Phalanx 1	4	1	3	62.5%	70.0%	III
Tibia, ds	4	0	2	66.7%		
Mc III+IV, ds	2	0	2	50.0%		
Mt III+IV, ds	2	0	0	100.0%		
Mp III+IV, ds	0	0	1	0.0%	61.5%	IV
Calcaneum	2	0	2	50.0%		
Femur, px	2	0	2	50.0%		
Ulna, px	2	0	8	20.0%	33.3%	V
Radius, ds	0	0	1	0.0%		
Tibia, px	2	0	1	66.7%		
Femur, ds	2	0	4	33.3%		
Humerus, px	1	0	0	100.0%	45.5%	VI
	62	1	33	65.6%		
Suine -- Bailey						
	Fused	E-Line	Unfused	%Fused	%Fused	
Scapula, ds	1	0	1	50.0%		
Humerus, ds	1	0	0	100.0%		
Radius, px	1	0	0	100.0%		
Phalanx 2	2	0	1	66.7%		
Acetabulum	0	0	2	0.0%	55.6%	I
Tibia, ds	1	1	0	100.0%		
Phalanx 1	0	0	1	0.0%		
Metacarpals	2	0	1	66.7%		
Metapodials	2	0	2	50.0%		
Metatarsals	0	0	0	--		
Calcaneum	2	0	1	66.7%	61.5%	II
Ulna, px	0	0	1	0.0%		
Tibia, px	0	0	0	--		
Femur, ds	0	0	0	--		
Femur, px	0	1	0	100.0%		
Radius, ds	0	0	0	--		
Humerus, px	0	0	0	--	50.0%	III
	12	2	10	58.3%		
px = proximal, ds = distal, E-Line = epiphsyseal line visible						

Table 4: Dholavira 1995: Epiphyseal Union Data for the Middle Town (all levels combined)						
Bovine -- Middle Tow					grouped	Age-
	Fused	E-Line	Unfused	%Fused	%Fused	Stage
Scapula, ds	28	0	0	100.0%		
Acetabulum	52	0	1	98.1%	98.8%	I
Radius, px	18	0	0	100.0%		
Humerus, ds	26	0	0	100.0%	100.0%	II
Phalanx 2	48	0	0	100.0%		
Phalanx 1	51	0	0	100.0%	100.0%	III
Tibia, ds	18	0	3	85.7%		
Mc III+IV, ds	13	0	1	92.9%		
Mt III+IV, ds	6	0	5	54.5%		
Mp III+IV, ds	18	0	7	72.0%	77.5%	IV
Calcaneum	6	0	5	54.5%		
Femur, px	17	0	11	60.7%	59.0%	V
Tibia, px	7	1	6	57.1%		
Femur, ds	12	0	3	80.0%		
Ulna, px	10	0	3	76.9%		
Radius, ds	11	0	1	91.7%		
Humerus, px	4	1	2	71.4%	75.4%	VI
	345	2	48	87.8%		
Caprine -- Middle Town						
	Fused	E-Line	Unfused	%Fused	%Fused	
Scapula, ds	22	0	1	95.7%		
Acetabulum	13	0	0	100.0%	97.2%	I
Radius, px	12	0	0	100.0%		
Humerus, ds	11	0	0	100.0%	100.0%	II
Phalanx 2	3	0	0	100.0%		
Phalanx 1	4	0	1	80.0%	87.5%	III
Tibia, ds	1	0	0	100.0%		
Mc III+IV, ds	0	0	3	0.0%		
Mt III+IV, ds	0	0	1	0.0%		
Mp III+IV, ds	0	0	1	0.0%	16.7%	IV
Calcaneum	6	0	2	75.0%		
Femur, px	1	0	7	12.5%		
Ulna, px	2	0		40.0%	42.9%	V
Radius, ds	0	0	3	0.0%		
Tibia, px	1	0	1	50.0%		
Femur, ds	4	1	3	62.5%		
Humerus, px	0	0	1	0.0%	42.9%	VI
	80	1	27	75.0%		
Suine -- Middle Town						
	Fused	E-Line	Unfused	%Fused	%Fused	
Scapula, ds	1	0	0	100.0%		
Humerus, ds	5	0	0	100.0%		
Radius, px	3	0	0	100.0%		
Phalanx 2	2	0	0	100.0%		
Acetabulum	1	0	0	100.0%	100.0%	I
Tibia, ds	0	0	3	0.0%		
Phalanx 1	0	0	0	--		
Metacarpals	0	0	0	--		
Metapodials	0	1	0	100.0%		
Metatarsals	1	0	0	100.0%		
Calcaneum	1	0	0	100.0%	50.0%	II
Ulna, px	4	0	1	80.0%		
Tibia, px	0	0	1	0.0%		
Femur, ds	0	0	0	--		
Femur, px	0	0	4	0.0%		
Radius, ds	0	0	0	--		
Humerus, px	0	1	0	100.0%	45.5%	III
	18	2	9	69.0%		
px = proximal, ds = distal, E-Line = epiphsyseal line visible						

Table 5: Skeletal Part Distributions						
	No. of specimens		Standardized No.		Proportion	
Medium Mammal	Bailey	Middle Town	Bailey	Middle Town	Bailey	Middle Town
Scapula, ds	20	38	10.0	19.0	10.2%	19.3%
Acetabulum	31	38	15.5	19.0	15.8%	19.3%
Radius, px	17	20	8.5	10.0	8.7%	10.2%
Humerus, ds	14	20	7.0	10.0	7.2%	10.2%
Phalanx 2	9	5	1.1	0.6	1.1%	0.6%
Phalanx 1	22	7	2.8	0.9	2.8%	0.9%
Tibia, ds	13	7	6.5	3.5	6.6%	3.6%
Mc III+IV, ds	12	5	7.5	3.0	7.7%	3.0%
Mt III+IV, ds	3	2	3.0	1.5	3.1%	1.5%
Mp III+IV, ds	12	4				
Calcaneum	22	13	11.0	6.5	11.2%	6.6%
Femur, px	9	14	4.5	7.0	4.6%	7.1%
Tibia, px	6	4	3.0	2.0	3.1%	2.0%
Femur, ds	13	9	6.5	4.5	6.6%	4.6%
Ulna, px	16	17	8.0	8.5	8.2%	8.6%
Radius, ds	4	3	2.0	1.5	2.0%	1.5%
Humerus, px	2	2	1.0	1.0	1.0%	1.0%
	225	208	97.9	98.5	100.0%	100.0%
	No. of specimens		Standardized No.		Proportion	
Large Mammal	Bailey	Middle Town	Bailey	Middle Town	Bailey	Middle Town
Scapula, ds	19	39	9.5	19.5	6.8%	8.6%
Acetabulum	51	100	25.5	50.0	18.2%	22.1%
Radius, px	16	21	8.0	10.5	5.7%	4.6%
Humerus, ds	18	34	9.0	17.0	6.4%	7.5%
Phalanx 2	19	58	2.4	7.3	1.7%	3.2%
Phalanx 1	28	74	3.5	9.3	2.5%	4.1%
Tibia, ds	12	22	6.0	11.0	4.3%	4.9%
Mc III+IV, ds	3	21	15.0	15.5	10.7%	6.8%
Mt III+IV, ds	6	12	16.5	11.0	11.8%	4.9%
Mp III+IV, ds	108	40				
Calcaneum	28	31	14.0	15.5	10.0%	6.8%
Femur, px	12	40	6.0	20.0	4.3%	8.8%
Tibia, px	13	15	6.5	7.5	4.6%	3.3%
Femur, ds	7	19	3.5	9.5	2.5%	4.2%
Ulna, px	17	21	8.5	10.5	6.1%	4.6%
Radius, ds	7	15	3.5	7.5	2.5%	3.3%
Humerus, px	5	10	2.5	5.0	1.8%	2.2%
	369	572	139.9	226.5	100.0%	100.0%

px = proximal, ds = distal

Standardized No. is the number of specimens divided by the number occurring naturally in the living bovid (i.e., 2 for all parts except phalanges which are 8 each for the Ph1 and Ph2)

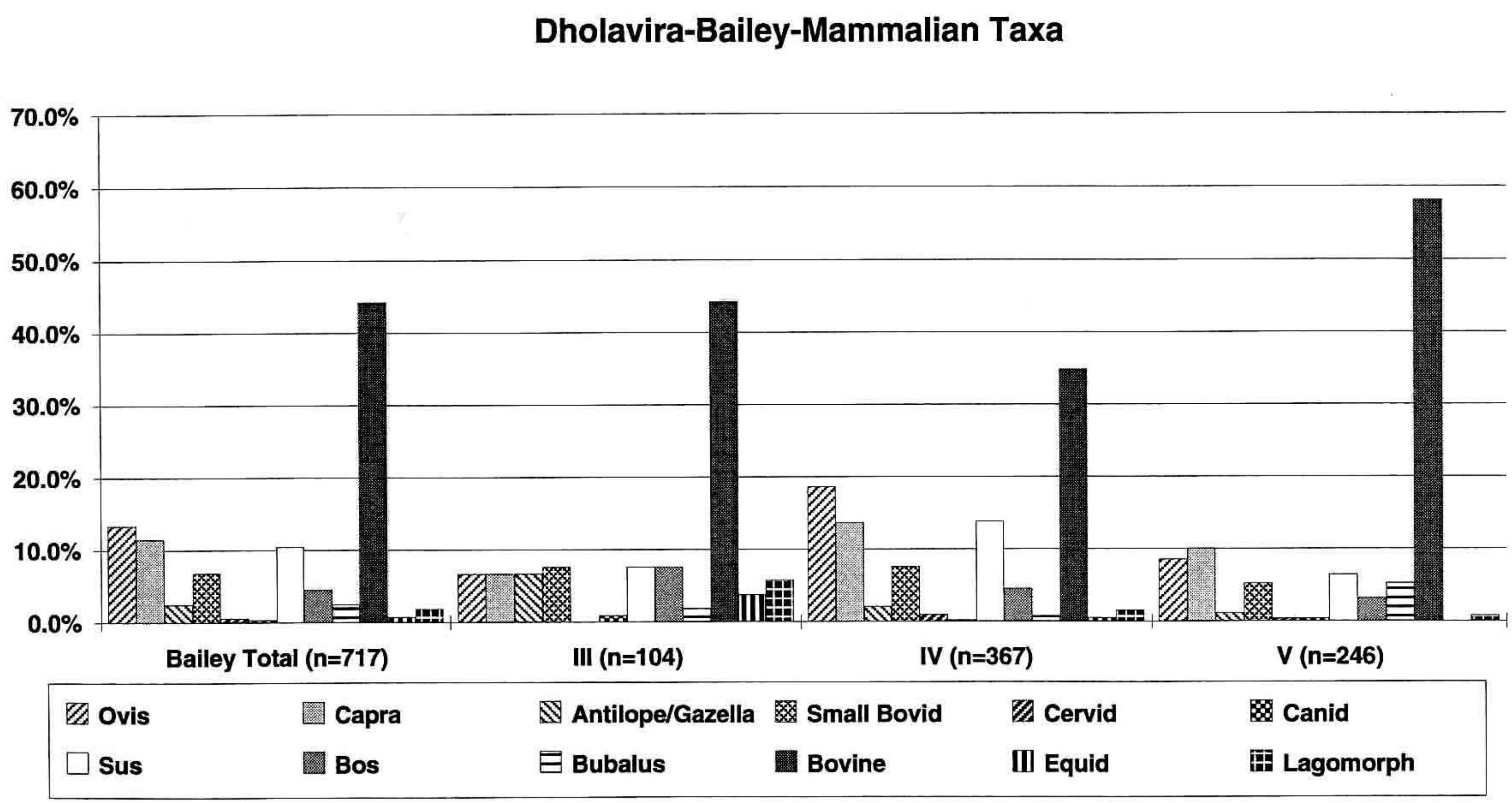


Figure 1: Proportions of different mammalian taxa represented in the identified bones from street deposits of the Bailey for Stages III, IV, and V.

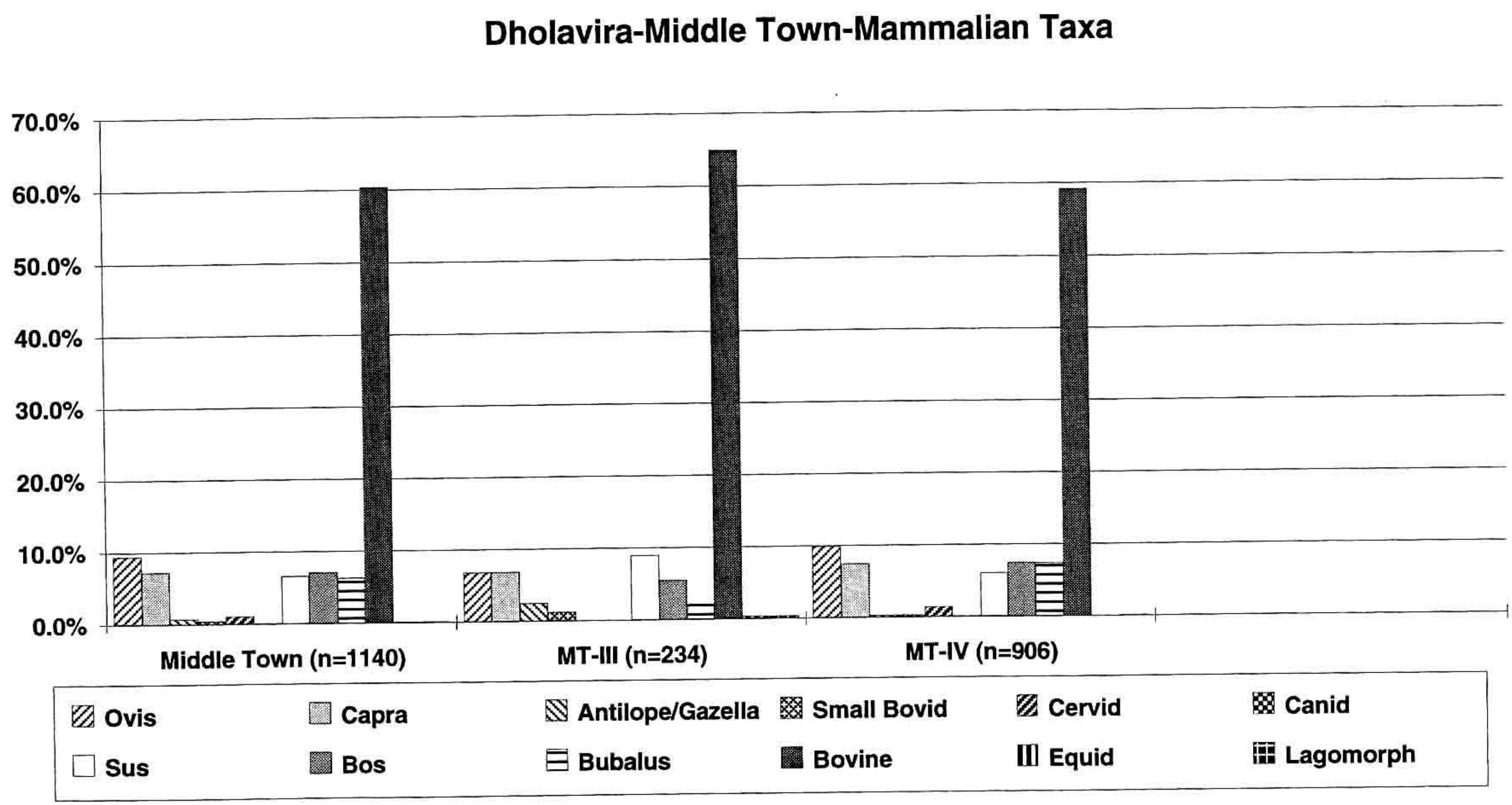


Figure 2: Proportions of different mammalian taxa represented in the identified bones from street deposits of the Middle Town for Stages III and IV.

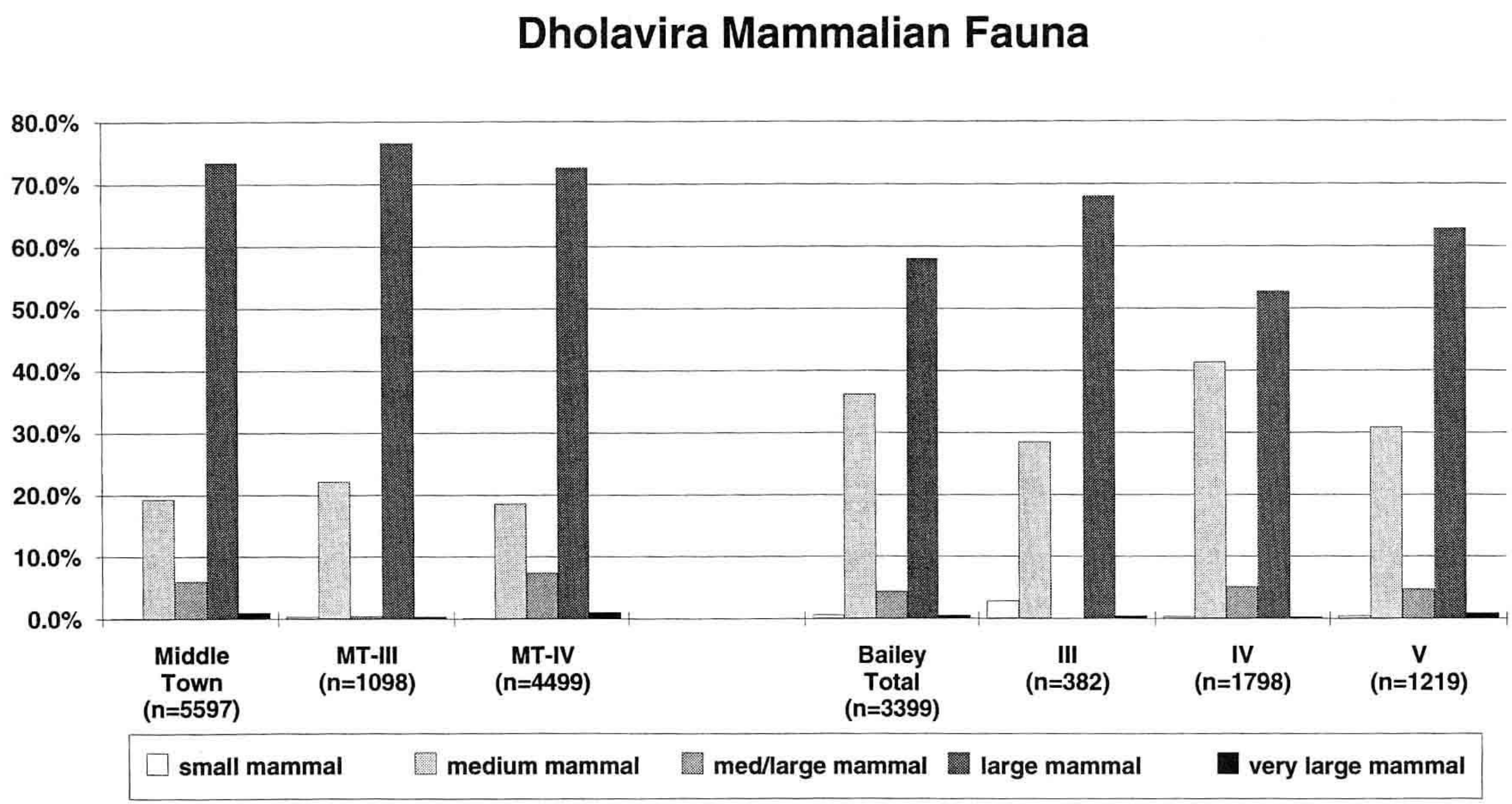


Figure 3: Proportions of mammalian size classes represented in the total bone assemblages from street deposits of the Bailey and Middle Town.

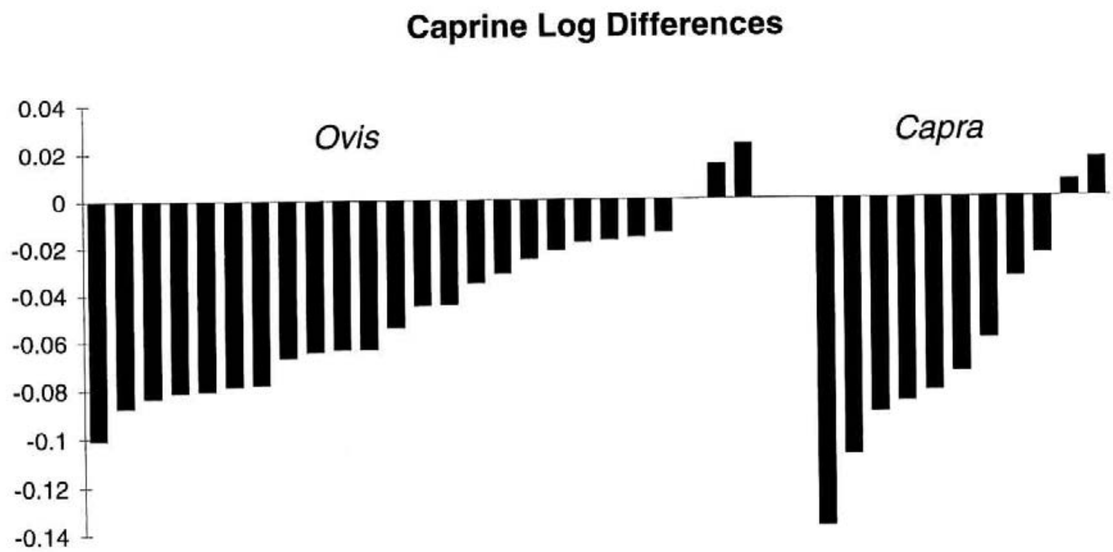
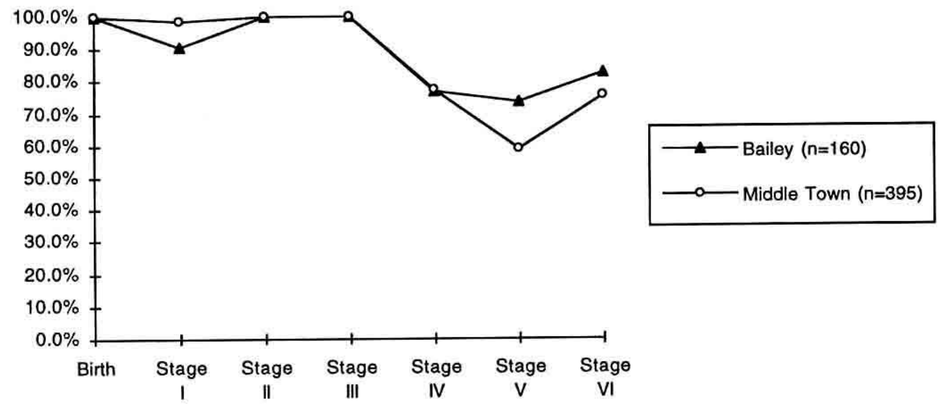
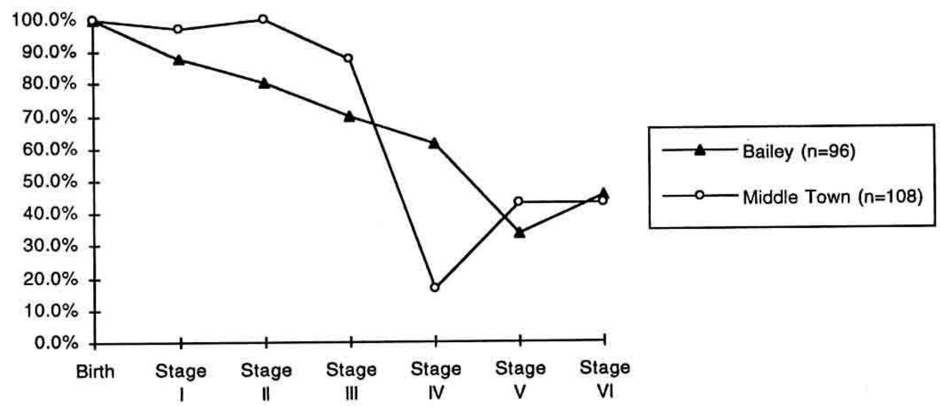


Figure 4: Difference of logarithms diagram for sheep (*Ovis*) and goat (*Capra*) from street deposits in the Bailey and Middle Town combined showing distribution of individual measurements in relation to those from standard animals.

Dholavira Bovine Survivorship Curves



Dholavira Caprine Survivorship Curves



Dholavira Suine Survivorship Curves

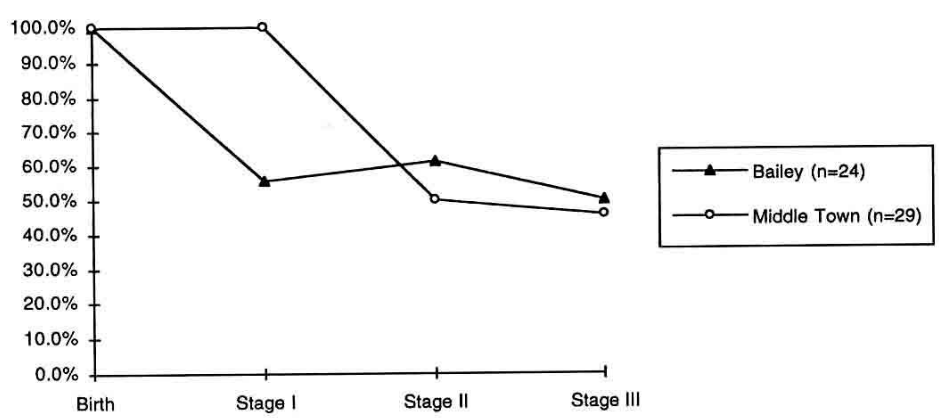


Figure 5: Survivorship curves for cattle and water buffalo (bovine), sheep and goats (caprine) and pigs (suine) from the Bailey and Middle Town, all periods combined. Stages I-VI for bovines and caprines and I-III for suines are age-stages calculated from epiphyseal union data.

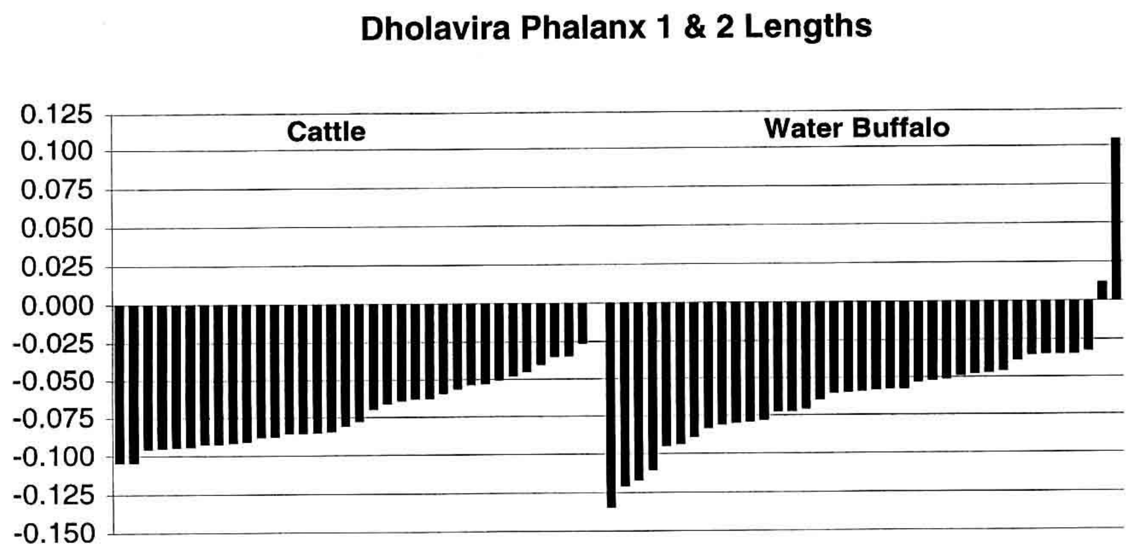


Figure 6: Difference of logarithms diagram for cattle (*Bos*) and water buffalo (*Bubalus*) first and second phalanges from street deposits in the Bailey and Middle Town combined showing distribution of individual length measurements in relation to the standard.

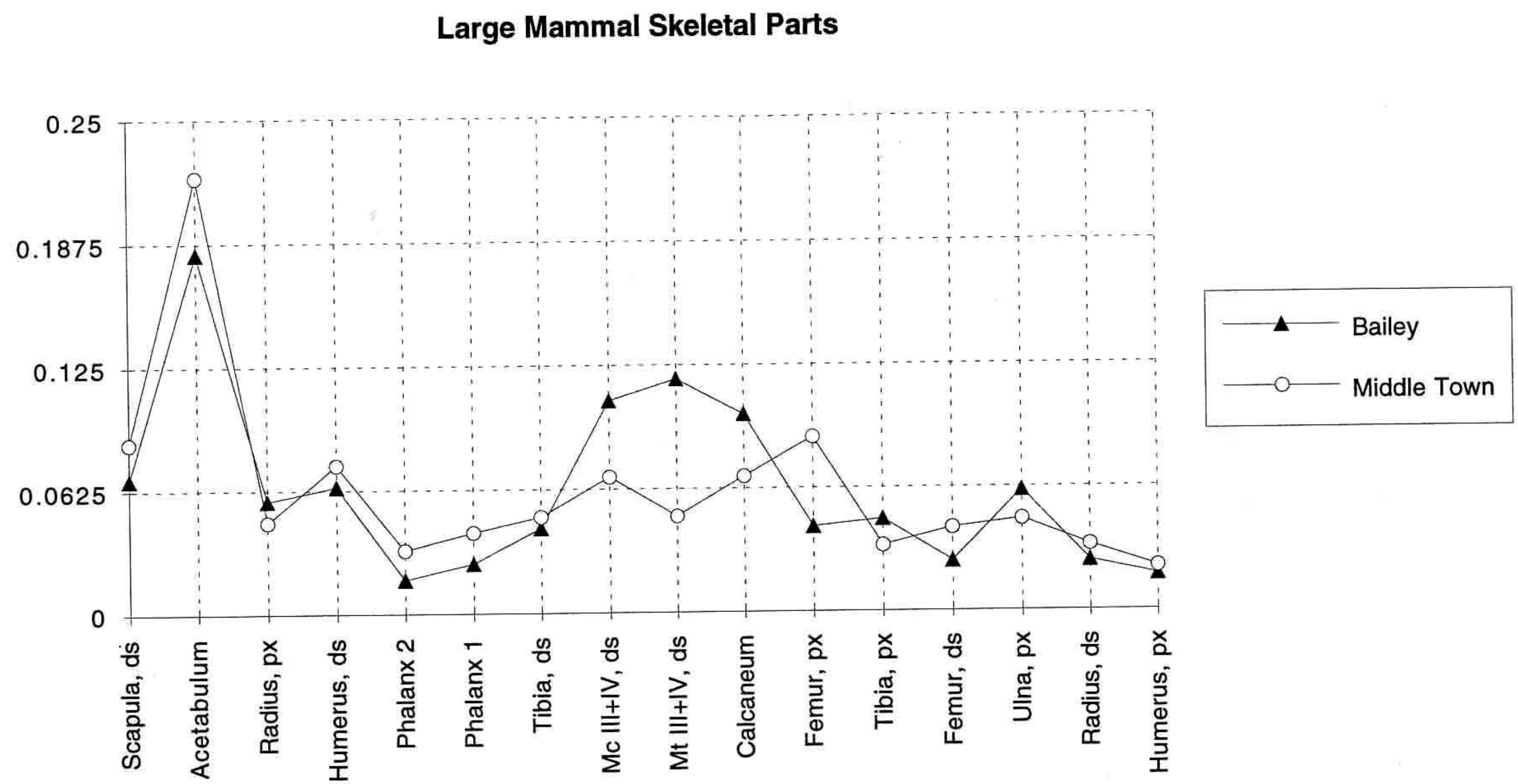


Figure 7: Percentage representation of large mammal skeletal parts from the Bailey and Middle Town arrayed in order of epiphyseal union.

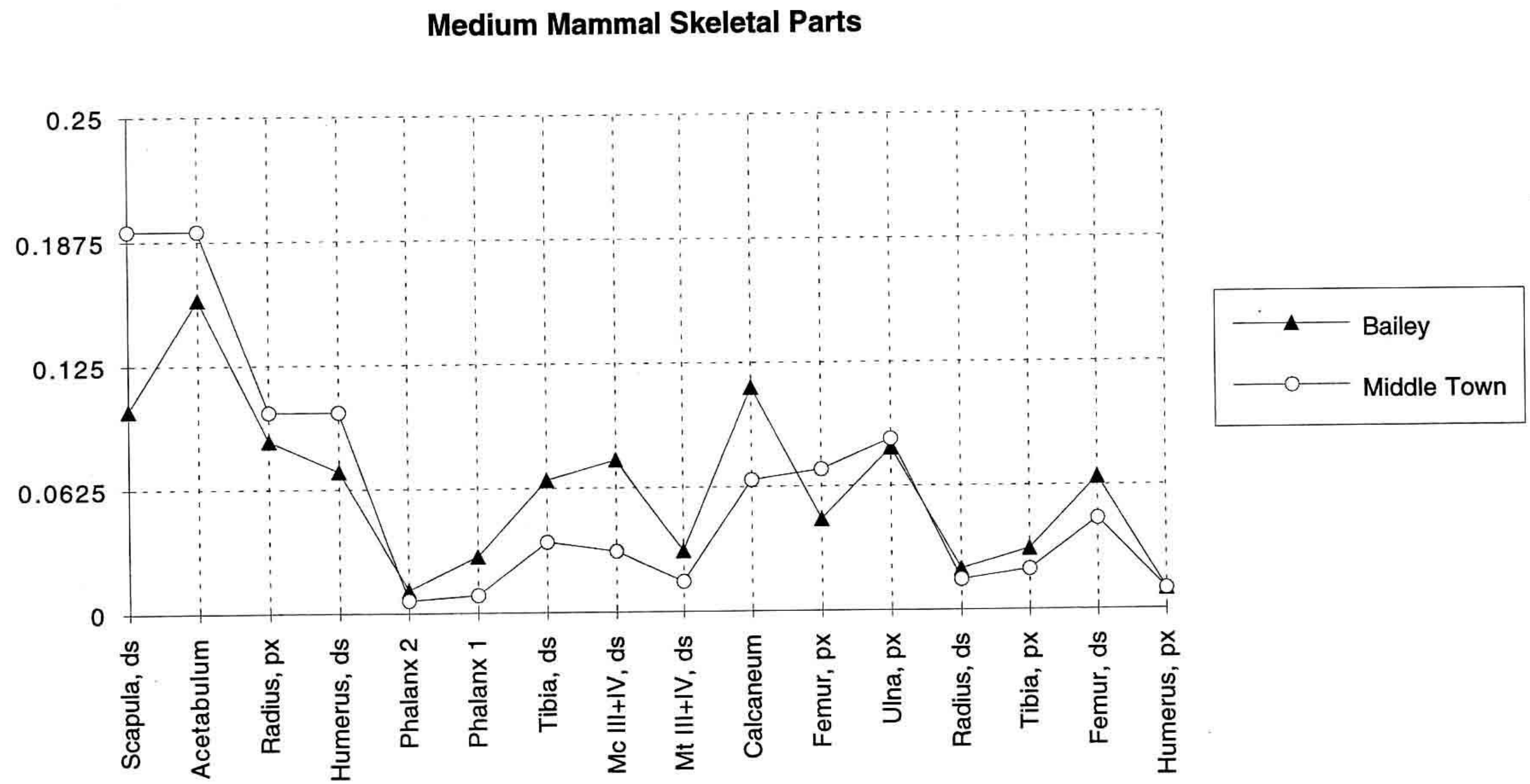


Figure 8: Percentage representation of medium mammal skeletal parts from the Bailey and Middle Town arrayed in order of epiphyseal union.

Chapter 12

The Authors of the Harappan / Indus Civilization

In the early twenties of the previous century, the discovery of the Harappan, also known as the Indus or the Indus-Sarasvati, civilization that mostly flourished in the second half of the 3rd millennium B.C. brought the question of its authorship in its train. The script that the Harappans developed and used ubiquitously could have shed some light on the vexed problem but it still remains undeciphered and as such the language(s), written in that, is still a mystery. The Harappans had carved out a large cultural and economic empire and far much larger sphere of interaction involving many literate, semi-literate and seemingly illiterate peoples of the ancient Mesopotamia, Iran, Central Asia, Afghanistan, the Gulf countries and the Arabian coast of Oman. And yet, there are hardly any clues coming to the fore as to suggest such an identity of the makers of the civilization that people easily understand and relate to an ethno- ft. linguistic or socio-religious group, e.g. Sumerian, Akkadian, Elamite, Aryan, Dravidian and so on. Neither their numerous creations of arts and crafts including those bearing on their religious faith and practices nor their villages, towns, cities, or edifices provide incontrovertible evidence to resolve the problem. In these circumstances, there are theories galore. The Indo-Sumerians, the Proto-Elamites, the Elamites the Aryans and the Dravidians, each in turn, has been credited by the scholars as the builders of this great civilization. However, there is no solution of universal acceptance to the problem in sight as yet. The civilization still remains a nameless wonder.

The excavation at Harappa (now District Sahiwal in Pakistan) was started in 1921 by Rai Bahadur Daya Ram Sahni under express orders from Sir John Marshall. A year later, Rakhal Das Banerji undertook digging at Mohenjo-daro. More digging

followed. In 1924, Marshall[1] examined the material from both the sites and realized that the finds

> *'belonged to the same stage of culture and approximately to the same age, and that they were totally distinct from anything previously known to us in India'.*

He 'lost no time' in publishing of them in the *Illustrated London News* which carried it in its issue of the 20th September, 1924.[2] In the following issue of the weekly Prof A.H. Sayce,[3] an Assyriologist, drew attention to the similarities between the Indian and the Sumerian antiquities and even ventured to assign an age to the former by making it contemporary of *'the Babylonian King Mansitusu and to that of the Third Dynasty of Ur'*. Further information on the comparative material was added by C.J. Gadd and Sidney Smith[4] in the same weekly of the 4th October of the same year. At the time thereabout, Ernest J .H. Mackay in a letter to Marshall[5] wrote about the similarity between the potteries from Mohenjo-daro and Kish and about an identical seal from pre-Hammurabi debris. The account of similarities rather long that led Marshall to name the newly found civilization as the "Indo-Sumerian" and also that it was contemporary to the Mesopotamian civilization of "the 3rd or 4th millennium B.C.". The very name also implied the source of authorship, too. Marshall rightly appreciated the close relationship of the people of Harappa and Mohenjo-daro with the Sumerians and the Proto-Elamites but he soon realized that the closeness was not strong enough to justify the term Indo-Sumerian which he replaced with 'Indus'.[6]

But the 'Indus' presence in Mesopotamia and Elam had already created such an impact that the scholars had made futile attempts to decipher the writing of the former by using the Sumerian, the Proto-Elamite (although the latter still undeciphered), the Elamite, the Minoan or Hittite scripts. Gadd and Smith, Waddell, Barton, Pran Nath and Hunter used the Sumerian or Akkadian scripts in the twenties

and early thirties immediately after the discovery of the culture. Marshall[7] had, however, realized quite early the futility of the methodology adopted by those scholars. Fresh efforts after decades were taken up by S.R. Rao, Mitchiner, Punekar and others.

Marshall[8] no way was ready to relate the Indus script or language to Sanskrit and held instead that the Indus civilization was pre-Vedic and non-Aryan. He premised his arguments broadly on two grounds, literary and archaeological. In both cases, the Vedic Aryans in general, without distinguishing the early Vedic, i.e. Rgvedic from the later Vedic, were put on the centre stage in order to draw a contrast with the Harappans. The theory of Marshall held such a find ground that a majority of the archaeologists, historians and social scientists in India and abroad accepted it with conviction and added some new points of divergence.

Even before the discovery of the Indus civilization there was in wide circulation a general belief regarding the Aryans[9] who have been depicted as far less civilized barbarians who thrived on stock-breeding and primitive agriculture and came riding horse-drawn chariots and resorted to large-scale destroying and looting of the establishments and fortified cities and towns of the firmly settled peoples who were regaling in opulence in the land of seven rivers including the Indus, the five rivers of the Punjab and the Sarasvati. They entered through the mountain passes of the north-west and captured the cattle, the fields and the pasturelands of their adversaries. The Aryans were not used to city life and, therefore, unacquainted with large and fortified settlements, monumental architecture, complex manufacturing and trade mechanism and seafaring, all of which were the essential attributes of the highly advanced, sophisticated and urban Harappans. Thus, there was a strong urban-rural dichotomy that existed between the two and that was reflected in their lifestyle, economy and thought, too. They utterly lacked the din and dazzle of the Harappan society. Further, the Aryans were regular fire-worshippers, soma-cult followers and their religious beliefs were simple and naive as they invoked the forces

of nature and deified them into gods and goddesses such as the sun, dawn, wind, storm-winds, waters, rivers, day and night, sky and earth, cow, horse, even some abstract principles and the ideas like cosmic order, existential principle and so on. One amongst their most powerful gods was Indra, their war- god as well as the god of clouds, rain, thunder and lighting. Their female deities occupied a secondary position while the Harappans were staunch followers of mother goddess and other female deities. Besides, there are a number of terracotta figurines of deities, animal deities whereas the Aryans were, perhaps, aniconic. More points of difference those are cited as existing between the Harappans and the Aryans were: the latter worshipped cow, the former the bull; the latter prized the horse much while it was absent in the former's stock; body armour of the latter have been absent from the former's tool-kit and so on. There is yet another practice that has been brought in to set these two peoples apart is the disposal of the dead as it was burying with the Harappans while it was cremating by the Aryans as a general rule. Two other points of divergence are that the Aryans were tall, fair-complexioned with an aquiline nose while their adversaries are referred to as having flat nose and black complexion. Importantly, the Aryans were iron-using people while the Indus civilization belonged to the Copper-Bronze Age. Lastly, although not the least, the Indus civilization flourished mostly in the 3rd millennium B.C. While the Aryans intruded into the sub-continent around C. 1200 B.C. or at most in c. 1500 B.C., long after the decline of the Indus civilization. Thus, those two were altogether two different worlds of contrast that was too wide and too sharp in their respective life ways, economics, technologies, religious thoughts and practices to allow any room for identification between the two. It may be added here that quite a few points as mentioned above have since been rendered invalid or superfluous. Ironically, the scholars by and large culled information from the works written previously or from translations.

Wheeler[10] brought in a dramatic turn to the theory. He had already revised the time-period of the Indus civilization as c. 2500 B.C. to 1500 B.C. on the basis of the freshly revised chronology of Mesopotamia and Elam. The terminal date was

now close to the supposed arrival of the Indo-Aryans in the north-west. It became now much easier to reinterpret the oft-repeated occurrences of fierce warfare between the newcomers and their pur-dwelling adversaries. Of course, the Aryans emerged victories after breaking asunder numerous cities of the non-Aryan Dasas, Dasyus, Asuras, etc. Drawing information from the Macdonell and Keith[11] on the nature of the Rgvedic *purs* of the victims of the Aryans, Wheeler cites that those were 'broad' (*prthvi*), 'wide' (*urvi*), 'autumnal' (*saradi* forts, 'with a hundred walls' (*satabhuji*), 'stone-made' (*asmanmayi*) and or 'raw', 'unbaked' (*ama*) and then reminds that Indra, the war-god of the Aryans, was given the epithet of *puramdara*, 'fort destroyer', who, repeatedly, breaks asunder numerous such *purs* of enemy kings for Aryan protege. Incidentally, it was Wheeler who for the first time had revealed formidable fortification walls with bastions and gateways around the citadel mound at Harappa. Equally dramatic was the climax when he stated, "on circumstantial evidence Indra stands accused".

Wheeler[12] was, however, fully aware of a possible anticlimax that could happen in the future possibly because he was aware of his tenuous hold on the time that concerned the terminal date of the civilization vis-a- vis the supposed arrival of the Aryans. Before and even after making the above-mentioned statement he had pointed out the risk involved in his bold assertion. He was also referring to Childe while stating, "The suggestion has indeed been made, very hesitantly, that the Cemetery H intruders 'may belong to the Aryan invaders'. Vatsa[13] has also suggested such a possibility while describing the Cemetery H pottery and its painted motifs by drawing parallels from the *Rgveda*, *Aitareya Brahmana*, Vedic Sutras, etc. This was why did he advise of digging, and more digging so that one might find, "in the short interval which can, at the most, have intervened between the end of Harappa and the first Aryan invasion, an unidentified but formidable civilization arose in the same region and presented an extensive fortified front to the invaders" and thereby "solve the problem".

It was the greatness of Wheeler that he honourably exonerated Indra when the loop holes were pointed out in his theory of the Mohenjo-daro massacre and when the Harappan chronology was revised with the help of the radiocarbon dates. His apprehensions had come true. With that, the curtain had fallen maybe for the time being, on his efforts of raising the Rgvedic *purs* from their mythical status to being historical realities.

Wheeler's interpretation of the Rgvedic data, paradoxically emphatic yet hesitant, was in a way confirmation of what was held by Marshall about the non-Aryan character of the archaeological repertoire of the Indus people. The former found many supporters like Childe,[14] Gordon[15] and Piggott.[16] Despite the inherent weaknesses Wheeler's theory has not yet lost its force. We are not concerned here with what R. von Heine–Geldern, B.B. Lal, Fairservis and others have said or hinted at about the Aryan movement into India or how M.S. Vatsa was implying by drawing analogies from the Vedic or its exegetic literature for interpreting the painted motifs on the Cemetery H pottery from Harappa. But we may certainly stress that the label of non-Aryan character of the Indus civilization still stuck to it largely and that has left there a wide fertile field to raise more theories.

Coming back to the Rgveda, we find therein several adjectives qualifying Aryan adversaries such as 'black'[17] (*krsna*), 'having black skin' (*krsna tvach*),[18] 'of black breed', (*krsna yoni)*,[19] 'black community' (*krsna vis*),[20] or 'having no (flat) 'nose' (*anas*).[21] Some of these appellations were clearly used for the Dasas and Dasyus, the arch-enemies of the Aryans. They were also called 'babblers' or 'defective in speech' (*mrdhravach*),[22] and on the religious side, they were 'following no faith' (*avrata*),[23] 'following a different faith' (*anyavrata*),[24] 'following no gods' (*adevayu*),[25] 'having no gods' (*adeva*),[26] 'phallus-worshippers' (*sisnadeva*)[27] and so on so forth. The above evidence fitted well with the hypothesis that the Harappans were the Dravida-speaking non-Aryans who are the second most dominant group in India. There are a little more than two dozens of languages and dialects of this language

family. In Baluchistan a group of people speak Brahui which is linked to the Dravidian language group. It is, therefore, largely believed that the Indus Civilization was built by the Dravidians who once ruled over the north-west of India before they were pushed southward by the invading Aryans and in the process gave a number of loan words to Sanskrit and also some gods, like Siva, cult of female power, Sakti, matronyms to many of the later Vedic teachers. It is also assumed that the cerebrals (th, d, dh and na) in the Sanskrit alphabet were adopted from the proto-Dravidian language.[28] They seek further support from the Dravidian facial features of the bronze dancing girls from Mohenjo-daro. This is why have several attempts been made to decipher the Indus script with the aid of Old Tamil. Fairservis[29] opines that the Indus script is a syllabic one consisting of approximately 400 sings. He sought help for deciphering it from the Proto-Elamite, or Linear Elamite, script (which however remains still unread) and the Dravidian language. Elsewhere, he has added that the languages closest affinity is to Tulu-Kannada in lexemic morphology and in lexemes proper.[30] "On this premise, he has deciphered the inscription of the 'proto-Siva' seal[31] as follows:

al-a kutu koramata an-il pir - an

(He joins assembled clans the high chief one).

And says that *An-il* was the paramount chief of four "sodalities", each represented by the animals depicted on the seal. The Indus script is believed to have link to the Elamite language which is supposed to be of the Dravidian group. Unlike the proto Elamite, the Elamite has been deciphered and both are said to have a wide area of distribution in southern Iran.[32] The linguists, David McAlpine and J.P. Mallory have advocated the relationship between the Elamite and the Dravidian languages and also a common Proto-Elamo-Dravidian source and assign Brahui a place "linguistically as well as geographically intermediate between the two major sub-groups".[33] Renfrew[34] has, however, refuted such a unity. "In the first place, the Elamo-Dravidian unity is a debatable one. And it is notable that the Dravidian

languages in recent times have been spoken by the hunter-gatherer communities of central and southern India". Bhagwan Singh[35] adds that that theory could have validity if "it is proved that the Indus civilization was inspired by any of the sub-cultures in South Iran." He does not rule out the presence of pockets of Dravidian dialects since pre-sendentary stage. And, regarding Brahui, he rightly observes:

> *We cannot ignore the crude reality that the Brahui tribes had hardly improved their lot remaining nomadic just in the vicinity of a proud culture.*

In 1969, Asko Parpola, and his colleagues[36] attempted to decode the script in which they have found many proto-Dravidian readings. According to Fairservis "The presentation of this (their) argument plus the approach used" by Parpola *et al* "is the most convincing so far advanced". As quoted by Lal,[37] these Finnish scholars have read in 1970 the so-called proto-Siva' (Pasupati) seal inscription on which the deity is surrounded by beasts whose lord he is as follows:

> ***Man of the star (Siva), the lord of …….***

In support of their hypothesis they (Asko *et al*) have cited a 8th - 9th century tradition of successive academies of poets. The last academy covering a time-period of 1850 years was taken by simple arithmetic calculation to the time of the Indus civilization. To Parpola, the Indus language, like the Dravidian appears to be an agglutinative language.[38]

Krishna Rao[39] have also claimed to have deciphered the Pasupati seal inscription as

Makhanasana,

Meaning, destroyer of Makha or Asura Makhas,

Richter-Ushanas[40] has read it as

arinada svapasyaya eka kavis

(He) is the only Kavi (seer) who by his power lets (the waters) flow.

All four followed different methodologies giving different values to the signs on the seal. The former, has however, arbitrarily left aside the two human figure signs from deciphering without giving any reason. The above should be enough to show the hollowness of the approach, methodology adopted the claims made by both the pro-Dravidian and the pro-Sanskrit scholars so far as the decipherment of the Indus script is concerned. B.B. Lal in his same book thoroughly critiqued the Finnish methodology and semiotics and cast doubt on the reliability of a tradition of far later times. Likewise, he has shown as how the reading of the proto-Siva seal inscription by Fairservis, Parpola *et al* on the one hand and on the other M. V.N. Karishna Rao and Egbert Richter-Ushanas who have read Sanskrit or proto Sanskrit in them.

Two other great scholars, one proto-Dravidian, namely I. Mahadevan, and the other proto-Sanskrit, S.R. Rao, have also made serious efforts. Mahadevan[41] has tried to adopt a rational approach by giving consideration to both the Indo-Aryan and the Dravidian nuances by being in search of 'layers of parallelism as well as different and divergent streams of parallelism'. Although he believes that the script contains a Dravidian language, yet a Harappan sign, word and its meaning may be reflected in Indo-Aryan and later tradition.

According to Rao,[42] the script is alphabetical containing just 20 signs having phonetic values while many of the signs, sometimes even three or four, represent one alphabet, e.g. 'p'. For assigning phonetic values, he compares signs in South Semitic script which contains about the same number of sings. But it is datable to c.

1600 -1200 B.C. How and when and through what made of borrowings? Curiously, when the said Semitic script did not meet his requirement Rao depended on the Sumerian for form and the Akkadian and the Ugaritic for strokes for determining vowels so as to make the writing suitable for Sanskrit. The example is the 'jar' sign of which 'U' part is the Sumerian and a couple of side strokes on either side are from Akkadian and Ugaritic cuneiform writing. Further, 'man' sign stands for vowel r as the Rgvedic word for man is nr and he conveniently ignores n part of nr as it did not suit his system of decipherment for the reason in his own words is:

> *The alternative value of 'n ' is not suitable because conjuncts formed by 'n' with p', 'k' 'b' etc. are very rare but conjuncts of 'r' with ‘p’, 'k', 'g', 't', 'd', etc. are common in Indo-Aryan.*

This, of course, goes against the normal acrophonic rule. There are quite a few such examples. Rao has, however, also shown the presence of conjunct consonants as well as voiced and voiceless stops, namely k, g, t, d, p and b.

Besides, the duplication of consonants right at the beginning like *ppa*, *mma* in word is unusual in Sanskrit, but quite usual in Rao's Sanskrit. Lal[43] has cited an inscription no. 7201 on p. 152 from Mahadevan's Concordance, which is consisted of three 'rake' signs followed by a 'man' sign, which in accordance with Rao’s scheme would read

ha ha ha r,

which means nothing howsoever.

B.B. Lal has been the most serious student as well as critique with utmost impartiality and frankness. His observation on the legacy of the Indus script needs all due consideration and further work. We cannot do any better than to quote him:[44]

The question of the survival of the Harappan signs was examined in some detail by the present writer wayback in 1960.[45] It was noted that many of the Harappan signs continued in the Chalco1ithic cultures of Central India, Gujarat and northern Deccan, which are broadly ascribable to the second millennium B. C. The signs passed on to the Megalithic cultures of South India, crossing even the 1 000 -B.C. line. In fact, on a Black-and-Red Ware pot from Sanur, assignable to the first half of the first millennium B. C., as many as three Indus signs occur in a row, signifying that these were not just hangover symbols but constituted as valid inscription as did the Harappan proper (Lal, 1960) This pretty late survival of the Harappan script would tempt anyone to stretch the time by a few centuries and forge a link between the Sanur inscription and the Brahmi script.

S. Gurumurth[46] has prepared a significant concordance of graffiti occurring on ancient Indian pottery from pre-Harappan, Harappan, Chalcolithic, Iron Age overlapping with Early Historical times as well as rock paintings and rock engravings. In all, he has recorded 3056 graffiti occurring on pottery. Out of those 2288 are single occurrences including 72 Brahmi letters while the remaining 768 are ligatured ones. There are a good number of graffiti in south closely resembling the Indus signs.

A recent find of a Neolithic polished celt at Sembiyan Kandiyur in Mayiladuthurai Taluka (Tamil Nadu) bears four signs which have been identified by Mahadevan[47] as a classical Indus text. According to him, the first two pictograms stand respectively for *Murukku-an*, who is a Tamilian god. He equates the first sign, i.e. the *murukku* symbol, with the one that was found on a seal from Vaisali (c. 1100 B.C.), or a pottery graffiti at Mangudi (Tamilnadu) and Muciri (Kerala) and then concludes "that the Harappans and the Neolithic people of Tamil country spoke the same language, namely Dravidian" as the latter were in contact with the Late

Harappan or post-Harappan people and the Mohenjo-daro gold was obtained from the Kolar gold mines of Karnataka. He also recalls a tradition from old Tamil literature that the Velir chiefs migrated from Saurashtra which was once a part of the Harappan civilization.

There are two more interesting examples of protogonism in favour of Dravidian vis-a-vis Sanskrit. R. Madhivanan[48] has worked on the premise that the Indus language was 'purely Dravidian' and as such proceeded to decipher the script by 'comparing it to the later Tamil Brahmi Script and analyzed the grammatical structure of the script matching it with that of the Dravidian'. To him each sign or combination of signs stands for a syllabic sound' while there occur at times pictographs as logo-syllables or morpho-syllables. His study shows that there are only 30 basic signs consisting of 12 vowels, 18 consonants, several pictographs. Many of them have alternative variants. In one case, i.e. *n*, there are unbelievably as many as 40. He has claimed to have deciphered more than 3000 seal inscriptions in which he mostly found proper personal names while a few provide place names and verbs. He[49] has also given his decipherment of the famous 10-sign inscription found at Dholavira which reads as follows:

Nadan Panniyan Nan Mannavan

His approach of reducing a huge number of signs into just 30 and conceiving of a very large number as alternative variants of various signs and taking many as pictographs, and each carrying a phonetic value gave him enough elbow room for decipherment. Also that the seals carry personal names of merchants, kings, priests, etc. provided him with further largesse.

Diametrically opposite is the approach, methodology and final decipherment by Natwar Jha49 who has read the same Dholavira inscription as follows:

mad -dwaidhah -rag- vedha-svaih-sahasradha

Obviously in Sanskrit! It is read from right to left. But some inscriptions on the seals are read by him from left to right. In yet another case, one inscription, as he says, reads from two different directions - three signs from right and the other three from the left, of course, in order to make it an intelligible text by allowing himself with elbow room. He has identified signs for three vowels (*i, r, b*) one each for *anusvara* (˙), *visarga* (:) as well as for all thirty-three Sanskrit consonants, besides 162 composite signs and 15 picto-logographs having phonetic values. He calls it old Brahmi which gave birth to the Asokan as well as Devanagari scripts. So far as the language is concerned, it is the Sanskrit of the *Nighantu* and *Nirukta* tradition and used on the seals for writing Vedic glossary.

Most amusing is the claims made by N.K. Verma[50] who has identified signs for Sanskrit alphabets on the basis of the symbols which are used by the Santhals of Bihar, Bengal, Orissa and Madhya Pradesh in ritual diagrams for invoking their tribal deities. He can read any inscription in no time but cannot explain the text without taking help from any possible languages of old or new in the world, e.g. Santhali, Sanskrit, Hebrew, Persian, Arabic, English, Hindi so on and so forth.

There is yet interesting evidence from the Easter Island in the Pacific. In 1932, Prof. Paul Pelliot informed the Academic des Inscriptions et. Belles -Lettres that Guillaune de Hevesy noticed[51] strangely closed similarities in about 44 signs of the Indus and the Easter Island scripts, the latter being engraved on wooden tablets. He found a supporter in Langdon who organized a team for further investigation which however, turned out to be abortive due to some eventful happenings. It is, however, worth probing, although it appears to be far too distant for finding out a possible linkage to the Harappans or their strayed seafarers.

B.P. Subbarayappa[52] has put forward an interesting theory that the Indus signs on whatever media stand for numbers ranging from 1 to 60,000 or so in various numerical forms and the numeration is of decimal, additive -multiplications system. Further, he holds that the majority of the Indus seals are quantitative records of agricultural production and administrative management and the animals on them can be co-related to the field products. Hence no language is sought although Rgvedic mythology attributed to the Harappans by the author.

The scholars have argued thus for the Sanskrit or the Dravidian language embodied in the Indus script as that is directly linked to the issue of authorship of the concerned civilization. Which is why has discussion revolved round the script. Much of it emanated from the position taken by Marshall, Wheeler and others right after the discovery of the Harappan Civilization. It naturally brought in the old Aryan problem with all its Indo-European overtones into debate which shows no signs of abating as yet. It entailed biological, linguistic and now archaeological approaches. While the first one has since lost much of its force and the second one has entangled in unending polemics, the last one ~too, is not providing any helping hand in view of the positions held by scholars in respect of the appearance of the Greeks, the Indo-Iranians and the Indo-Aryans all of which are closely related old peoples who were speaking languages having a common root. In all deliberations, the J:?gveda being the oldest composition and archaeology which deals with the material remains left behind over time and space need vigorous as well as rigorous effort until the script, like Linear B of Greece, is cracked and thereby puts the raging controversy at rest. In recent decades, it is observed that many of the archaeologists, particularly the foreigners, carefully avoid any exclusive discussion on the topic of authorship as to many in the subcontinent, to some outside scholars as well, it has become an emotive or ideological issue. That should not, however, be any deterrent for keeping the debate alive for the sake of academics.

Much of the above that was told in favour of old Sanskrit or old Tamil was based on the individual interpretation of the Indus signs by invoking phonetic value, pictographic value, or ideogram value that was premised on piecemeal approach or at the cost of consistency. Even those who drew information from the Rgveda, or the other Vedas or their exegetic literature relied on old translations, surely not studying those in the language those were composed.

In recent years, many scholars studied the original texts and propounded that the pre (early) Harappans, or the Harappans, or the late Harappans were the Rgvedic Aryans, or their adversaries were the bearers of the Harappan Civilization or else the Vedic culture was co- existing since the beginning or at some stage as a developmental stage.

In this connection, it should be most opportune to recall what Wilson expounded as early as the middle of the nineteenth century.

H.H. Wilson, an exceptionally gifted and erudite scholar of Sanskrit, including the Vedic literature, wrote brilliant introductions and notes and references to each of the first three volumes containing his translation of the first five *mandalas* of the *Rgveda* in the years 1950, 1954 and 1957 respectively. But he could not do so for the next three volumes of the remaining *mandalas* because of his death. He had, however, left behind his translation which was published subsequently, of course, without any introduction and notes. The discovery of the Indus civilization was yet more than six decades away. There is little doubt in believing that, had he survived till then, he would have lost no time to identify it with the *Rgveda* times. Hereunder is given a glimpse of Wilson's world view of the *Rgveda* :[53]

> *That the Hindus were not Nomads, is evident from the repeated allusions to fixed dwellings, and villages, and towns; and we can scarcely suppose them to have been in this respect behind their barbarian enemies, the overthrow of whose numerous cities is so often*

spoken of. A pastoral people they might have been, to some extent; but they were also, and, perhaps, in a still greater degree, an agricultural people, as is evidenced by their supplications for abundant rain and for the fertility of the earth, and by the mention of agricultural products, particularly barley (1.5 6. 15). They were a manufacturing people; for the art of weaving, the labours of the carpenter, and the fabrication of golden and of iron mail, are alluded to; and what is more remarkable, they were a maritime and mercantile people.

Elaborating on the same theme in volume II, Wilson adds[54] that both the Asuras and the Dasyus on the one hand and the Aryans on the other were "similarly located" in "towns or cities:

In their towns or cities we find existing the arts, sciences, institutes, and vices of civilized life, golden ornaments, coats of mail, weapons of offence, the use of the precious metals (1.18 6.4), of musical instruments, the fabrication of cars, and the employment of the needle; and although we have not the allusions to traders by sea that occur in the first Ashtaka, yet the unequivocal notices and mention of the ocean, are so frequent and precise as to prove beyond doubt its being miliarly known and occasionally navigated, we have also the knowledge of drugs and antidotes, the practice of medicine, and computation of the divisions of time to a minute extent, including repeated allusions to the seventh season or intercalary month (I. 22.8.15). We have mention, not only of *Rajas*, but of envoys and heralds, of travellers, and of *Sarais*, or places provided for their refreshment………..

The same advanced state of civilization may be inferred from the degree of perfection to which the grammatical construction of the language had been brought, and still more from the elaborate system of metrical composition………..

In Introduction to Vol. III[55], he informs further:

> In another, we have specified a structure with a thousand columns, which, whether a palace or a temple, must have been something different from a cottage; and again, a supplication is put up for a large habitation, which could not be intended for a hut: cities with buildings of some pretence must obviously have been no rarities to the authors of the hymns of the *Rgveda*.

In recent years, a number of scholars, namely Bhagwan Singh, [56] Shamsuzzoha Manik and Shamsul Alam Chanchal,[57] R.N. Nandi,[58] R.S. Bisht[59] and Shivaji Singh[60] have expounded what was propounded by Wilson with his rare insight although most of them failed to acknowledge that was due to him. However, these scholars, together with B.B. La1,[61] S.R. Rao,[62] S.P. Gupta,[63] D.N. Tripathi[64] and some others added a few more points like the find of fire-alters at Kalibangan, Banawali, Rakhigarhi and Lothal., disappearance of the Saraswati during C. 2000 - 1900 B.C. being coincidental to the decline and break-down of the urban system of the Harappans and that the territory of the Harappans being co-terminus with that of the *Rgveda* Aryans.

Nicolas Kazanas believes that it was the pre-Harappan culture that is reflected in the *Rgveda*. Agreeing with Gregory L. Possehl's presentation of environmental and geological data, he concludes that the river "could have flowed down to the sea only before 3200 at the very latest, preferring a date very closer to circa 3800". He also dismisses physical existence of the man-made Furs of the *Rgveda* as being a fort, rampart, etc. At best, those were just metaphorically divine or demonic - a view somewhat shared by Bhagwan Singh who otherwise firmly believes that the Harappans were "the Vedic Aryans who were settled in India since long ago". Adding that by and large they were peace-loving people. Shiwaji Singh holds that the *Rgveda* culture seems to be anterior to, contemporary of and posterior to the Harappan civilization. He also postulates that the Harappan society was a

complex society in which the Aryans and even non-Aryans were co-existing and had possibly pockets of influences. Whereas Allchins feel that the Harappans were already present possibly sometime at a later stage of the mature Harappan times. The question of the authorship of the Harappa culture is still a moot point with no sign of solution until the script is decoded and the language(s) written in that is understood.

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1 Marshall, John, 1923-24, Exploration and Research, Harappa and Mohenjo-daro, *Annual Report of the Archaeological Survey of India*, 1923-24: 47-51.

2 Marshall, John, 1924, First Light on a Long Forgotten Civilization, *Illustrated London News*, 20 September, 1924, 528-32, 548.

3 Sayce, A.H, 1624, Remarkable Discoveries in India, *Illustrated London News*, 27 September, 1924: 566.

4 Gadel C.J. and S. Smith, 1924 The New Links between Indian and Babylonian Civilization, *Illustrated London News*, 4 October 1924: 614-16

5 Marshall, John, 1924, First Light on a Long Forgotten Civilization, *Illustrated London News*, 20 September, 1924, 528-32, 548.

6 Marshall, Sir John, 1925-26 Exploration, Western Circle, Mohenjo-daro, *Annual Report of the Archaeological Survey of India*, 1925-26: 72-98.

7 Marshall, Sir John, 1931 *Mohenjo-daro and the Indus Civilization* 3 Volumes, London: 15-26.

8 Ibid, 102-12.

9 Bisht, R.S., 1999 Harappan and the Rgveda: Point of Convergence, The Dawn of Indian Civilization, 1999: 394-95. and Fairsevis, Jr. Walter A, 1971 *The Roots of Ancient India*, 1971: 345.

10 Wheeler, R.E.M., 1947 Harappa 1946: The Defences and Cemetery R 37, *Ancient India 3*, 1943: 82.

11 Macdonnell, A.A. and A.B. Keith, 1912 *Vedic Index of Names and Subjects*, 2 Vols., London, 1912.

12 Ibid: 81-83.

13 Vatsa, Madho Sarup, 1940 *Excavations at Harappa* (reprint) New Delhi 1999: 208-209.

14 Childe, V.G., 1957, *New light on the Most Ancient Ea*st, London.

15 Gordon, D.H., 1958, *The Pre-historic Background of Indian Culture*, Bombay

16 Piggott, Stuart, *Prehistoric India to 1000 B.C.* Baltimore.

17 Rgveda, IV. 16.13.

18 *Ibid*, IX. 41.1.

19 *Ibid*, II. 20.7.

20 *Ibid*, VIII, 62.18.

21 *Ibid*, V. 29.10.

22 *Ibid*, VIII, 6.3.

23 *Ibid*, IX. 41.2.

24 *Ibid*, VIII. 59.11.

25 *Ibid*, VIII. 59.11.

26 *Ibid*, III. 1.16; X. 138.4.

27 *Ibid*, VII. 21.5; X. 99.3.

28 Pande, G.C., 1999, The Vedas, their Authors and Significance, *The Dawn of Indian Civilization up to 600 B.C.*, ed., G.C. Pande, Delhi, 1999: p. 562 note 60.

29 Fairservis, Walter, *op. cit*: 278-79.

30 Fairservis, Walter, 1992, *The Harappan Civilization and its Writing*, New Delhi: 117.

31 *Ibid*, p. 200.

32 Lamberg-Karlovsky, 1973, Urban Interaction on the Iranian Plateau, Proceedings of the British Academy, LIX, London: 7-43 and The Proto-Elamites on Iranian Plateau, *Antiquity*, 52: 114-20.

[33] Mallory, J.P., 1989, *In Search of the Indo-Europeans*, London: 44-46 and McAlpine, Daid W., 1981, *Proto-Elamo-Dravidian: The Evidence and its Implications*, Philadelphia.

[34] Renfrew, Colin, 1991, Before Babal: Speculations on the Origins of Linguistic Diversity, *Cambridge Archaeological Journal*, I, 1.3-23.

[35] Singh, Bhagwan, 1995, *The Vedic Harappans*, Delhi: 335.

[36] Parpola, Asko, S. Koskenniemi, P. Parpola and P. Alto, 1969, *Decipherment of the Proto-Dravidian Inscriptions of the Indus Civilization*, Copenhagen.

[37] Lal, B.B., 1997, *The Earliest Civilization of South Asia*, New Delhi: 209-10.

[38] Parpola, Asko, 1981, Interpreting the Indus Script, *Indus Civilization, New Perspectives*, ed., A.H. Dahi, Islamabad.

[39] Krishna Rao, M.V.N., 1992, Indus Script Deciphered, Delhi.

[40] Richter-Ushanas, 1992, The Fifth Veda: The Indus Seals in Comparison with the Rgveda, Germany.

[41] Mahadevan Iravatham, 1979, Study of the Indus Script through Bilingual Parallels, *Ancient Cities of Indus*, ed., G.L. Possehl, New Delhi: 260-264.

[42] Rao, S.R., 1982, *The Decipherment of the Indus Script*, Bombay.

[43] Lal, B.B., *op. cit.*

[44] Lal, B.B., *Ibid*: 207.

[45] Lal, B.B., 1960, From the Megalithic to the Harappan: Tracing Back the Graffiti on the Pottery, *Ancient India, 16*: 4-24.

[46] Gurumurthy, S., 1999, *Deciphering the Indus Script (from Graffiti on Ancient Indian Pottery),* Chennai.

[47] Mahadevan, Iravatham, 2006, *A Note on the Murukku Sign of the Indus Script in Light of the Mayiladuthurai Stone Axe Discovery* (A Typed Note dated My 6, 2006): 1-2 and Kalyanaraman, S., 2006, *Engraved Celt Tool of Sembiyan-Kandiyur with Sarasvati Hieroglyphs: Calling-card of an artisan* (Typed Note): 1, dated 30 April, 2006.

[48] Madhivanan, R., 1994, *Phonetic Value of the Indus Script*, Madras and Madhivanan, R., 1995, Indus Script among Dravidian Speakers, Chennai.

[49] Jha, D.N., 1996, *Vedic Glossary on Indus Seals*, Varanasi.

[50] Verma, N.K., *Decipherment of Indus Inscriptions: A Contribution of Tribal India* (unpublished Typed Monograph)

[51] Possehl, G.L., 1999, *Indus Age: The Beginnings*, New Delhi: 93-95.

[52] Subbarayappa, B.P., 1996, *Indus Script: In Nature and Structure*, Madras.

[53] Wilson, H.H., 1977, *Rg-veda Samhita Vol. I*, Introduction (reprint), Delhi: xxxix-xl.

[54] *Ibid*, Vol. II, Introduction: xi-xii.

[55] *Ibid*, Vol. III, Introduction: xi-xii.

[56] Singh, Bhagwan, 1995, The Vedic Harappans, New Delhi and Singh, Bhagwan, 1997, *Harappa Sabhyata aur Vaidika Sahitya*, Delhi.

[57] Manik Samsuzzoha and Shamsul Alam Chanchal, 1995, *The Aryans and the Indus Civilization*, Dhaka.

[58] Nandi, R.N., 1989-90, Archaeology and Rgveda, *Indian Historical Review, Vol. 16*, 1-2, Delhi: 35-75 and Nandi, R.N., 1994-95, Aryan Settlement and the Rgveda, *Indian Historical Review 21*, 1-2, Delhi: 9-36.

[59] Bisht, R.S., 1999, Harappans and the Rgveda: Points of Convergence, *The Dawn of Indian Civilization upto 600 B.C.*, ed. G.C. Pande, Delhi: 393-442; Bisht, R.S., 2005 Rgveda and the Harappan Civilization, *A Discourse on Indo-European Languages and Culture*, ed. D.N. Tripathi, Delhi: 152-72 and Bisht, R.S., 1998 Some Glimpses of Mercantile and Maritime Activities of the Rgvedic Aryans, *Marine Archaeology of Indian Ocean Countries*, ed. S.R. Rao, Goa.

[60] Singh, Shiwaji, 1997-98, Sindhu and Sarasvati in the Rigveda and their Archaeological Implications, *Puratattva* 28, New Delhi: 26-38.

[61] Lal, B.B., 1997, *The Earliest Civilization of South Asia*, Appendix: 283-87 and Lal, B.B., 2005, *The Homeland of the Aryans: Evidence of Rigvedic Flora and Fauna and Arebeg*, New Delhi.

[62] Rao, S.R., 1979, Lothal: 195-62, New Delhi: 248-51.

[63] Gupta, S.P., 1996, *The Indus-Saraswati Civilization: Origins, Problems and Issues*, Delhi.
[64] Tripathi, D.N., 2005, The Indo-European Homeland: An Indian Perspective, *A Discourse on Indo-European Languages and Culture*, ed. D.N. Tripathi, New Delhi: 21-41.

Conclusion

The foregoing account should make it obvious that Dholavira is exceedingly important for extending the dimensions and depth to the Harappan civilization. Its excavation has indeed added many new facets, hitherto unknown, to the personality of the civilization. Some of the significant contributions are enumerated below:

1. It has provided an authentic and stratigraphically well documented account of the evolution, culmination, degeneration and transformation and finally complete de-urbanisation of the Harappan civilization, it is expressed in a 14 m of cultural debris which is present only in the Castle mound, is divided into seven cultural stages, through which helped reconstruct the story of the civilization on one hand and also emphatically demonstrated the growth as well as decline of settlement because with the evidence collected from here it was ascertained at what stage of development different components of the settlement were founded or deserted.

2. For example, the Bailey and Middle Town and Multi-purpose grounds along with their fortification systems came into being in Stage III. Although the rudiments of regimented planning had appeared in Stage I itself, in Stage III it got the form of planning for which the Harappans are so well known. Subsequent to the earthquake that occurred at the end of Stage IIIA, the settlement, which was a town till then, assumed a full-fledged cityscape, when the Lower Town came into existence. This devastating event compelled the inhabitants to undertake large-scale repairs, which also set the process of reorganisation and modification in the layout, particularly at Castle, Bailey, and Middle Town. However, at this point of time, Annexe was abandoned.

3. Very intricate and integrated fortification system is also a new element in the Indus Valley. For the first time, a multipartite, with several enclosed enwalled divisions was brought within a general,

or rather an outer fortification, which is a unique feature because; it has not been found at anywhere else at Harappan sites. The Castle that was secured by massive defensive walls furnished with gates, bastions outer as well as inner, and facilitating the outflow of storm water through a drain that descended into the Bailey. It was integrated into the outer fortification by means of another fortification that ran between the Bailey through Annexe.

4. The fortification of Bailey was made attached to the western arm of Castle's fortification; likewise that of Middle Town which was extended southwards to enclose the Great Ground or Plaza, was attached to the northern arms of fortification of Castle as well as Bailey. Several cross walls in the open spaces which span between the outer fortification and inner fortifications, running on the north, northwest and south also serve the purposes of the said integration because the considerable to modest thickness of these features indicate that those not only separated water tanks from each other, but also serve the purpose of movement of humans and materials.

5. A very wide embankment that partly bounded the western bank of the Manhar and became through a tortuous run to become the southern side of East Reservoir, and further on it facilitated movement towards the east gate of the Castle.

6. Unlike that of Mohenjo-daro, Castle at Harappa and the town of Kalibangan, the orientation of the entire Dholavira settlement and its components runs from east to west. In relation to the magnetic north, the planning is about 4.5^0 off towards west. Interestingly, the *in situ* square blocks of pillar elements of East Gate and North Gate also gave the reading of about 4.5^0 off the north.

7. A long and broad open space exist between the Citadel and Lower Town of Mohenjo-daro, as well as Kalibangan, but their precise nature and purpose could not be fully understood, thus leading to

different interpretations by different scholars. It was for the first time this open space which lies athwart between Citadel and Middle Town turned out to be a feature that may have been put to different uses such as community gathering on special occasions, games and sports, and sometimes used for trading purposes. On all sides, there were provision of stands and running platforms all along the length for sitting the spectators, suggesting the nature and use of the plaza. Some interesting evidence came from the passage of East Gate as well as West Gate. There are deep parallel rut marks on stones in the former; there were deep striations in the latter, which clearly suggested how a cart took a turn on a right angle in the passageway. It was well maintained all throughout by laying fresh floors occasionally. Each floor, particularly closer to the platform of North Gate, bore series of post-holes suggestive of that temporary stalls were put up by making use of wooden poles roofed with sticks and grass; perhaps these were done when trading season started. This plaza came into existence certainly in Stage IIIA and maintained as such, all throughout the occupation of the site, although underneath these floors, there are found some structures along with the pottery of Stage II, indicating that settlement was extended northwards during that time. Very interestingly, the local people call this field as 'bazaar'.

8. Some gates have been found at Harappa, Mohenjo-daro, Kalibangan, Bagasra, Surkotada, possibly Shikarpur, but nowhere the majesticity and completeness can be seen. Here, at Dholavira, the gates not only stand to a height of more than four metres, particularly in respect East and North gates of Castle, but are also furnished with a chambers, one in the case of East Gate and two in North Gate. Besides, the chambers were lined up with pilasters and pillars of beautifully cut and polished limestone members of various forms and shapes. It was also evidenced that both ends of passageway were fitted with doors. The doors have certainly come into existence in Stage IIIA and continued as such through Stage V.

Late Harappans of Stage VI wrought some destruction in North Gate from where the central columns were removed or dislodged. It appears that both chambers of North Gate were connected by wooden floor across the passage. The South Gate that was made concealed and was leading to the central South Reservoir was later on blocked. At what point of time it is not clear.

9. All divisions of the city were well planned. While the arterial street of Middle Town ran uninterruptedly from west to east, the corresponding street in Lower Town which is connected to it, goes tortuously; on the other hand, north – south streets or lanes of Middle Town run in zig-zag fashion but in Lower Town these are straight and uninterrupted.

10. Quite curiously, the ground plan of Middle Town has many projections and recesses. The main part of it seems to have consisted of two-and-half blocks on either side of the arterial street. The plan of the first two very closely resembles that of a developed temple of north India and the third one on the east is just half of that. This plan results in creating lot of open space on three sides, viz., north, south and west. In Stage IIIA, the southern part of Middle Town was an additional feature running from east – west continuously but the same was made devoid of structures in the following stage, and was possibly used for seating spectators on its south, trending slope. Likewise, Lower Town has also many open spaces owing to the projections and recesses in the built-up area.

11. Another significant contribution was an excellent and efficient water management system. Both the monsoon channels were spanned with weirs at certain points, not only for ponding water but also diverting it to the cascading series of reservoirs on the east, south and west. However, on the west it needs to be investigated that whether all the partitioned open spaces are reservoirs or not.

12. The East Reservoir that lies to the east of Castle was the largest among all. Its ascertained depth is 10.6 m from the surrounding level plain. Its length and width like any part of the city was proportionate giving a ratio of 2:5, it has certainly been created in Stage III, and possibly deepened and widened after the earthquake. It is furnished with flight of steps at its northwest, northeast and southwest corners, each contained about 30 steps. Outlet channel was near the south-eastern corner. It was possibly devastated sometime in Stage V and was never made functional thereafter. Only certain part close to the eastern stairs was cleared of sand and a well was cut in the rock, it was enclosed by retaining walls. It was the same time when all other reservoirs also became half filled with water borne sand and were never made operational.

13. On the southern side, between Castle and Annexe were created a chain of reservoirs, five of which were exposed. The central one is the most sophisticated. It is largely cut through the rock and was furnished additionally with an obliquely oriented deeper part on the eastern side. Wherever the rock was missing, masonry that is of superb workmanship was used. As usual, all the reservoirs were interconnected. The central one particularly in its glory was connected to the South Gate of Castle through a flight of steps, which has been damaged considerably.

14. Equally interesting is the network of storm water drains in the Castle which brought to water to the main drain which finally pierced through the western arm of fortification and cascaded down into another drain in the Bailey, through which the water flew into the reservoir that was carved out in the western part of Bailey.

15. In the Middle Town, it was observed that the open spaces particularly on the west and south were used as dumping grounds.

16. There is an extra-mural enclosure attached to the southern wall of outer fortification and was approached through a obliquely running passage and a gate opening from the side of Annexe. It is postulated that it may have been royal livestock yard.

17. Graves are found extensively on the east, north and west of the settlement. Only the western one was fairly investigated because it yielded much Harappan pottery. Graves of various shapes, sizes and types were present in the cemetery. There were north – south oriented cist burials, east – west oriented graves, cairns, cairn with cists, and a few impressed tumuli. On investigation it was found that all of them barring one which contained an inhumation were, just cenotaphs or memorial structures raised in honour of the deceased. Those contained pottery offerings, sometimes accompanied with jewellery consisting of some beads of semi-precious stones, pieces of gold. But, no skeletons of bodily remains, again barring one in which few pieces of human bones were found.

18. In the western cemetery, most impressive are the hemispherical tumuli. Two of them were investigated. It was found that in the centre of both, a large and deep rock-cut chamber was cut around which two-tiered brickwork was raised. In one case, in the central part there were radial walls, whereas in the other there were no such provisions. The largest one is 30 m in diameter and an extant height of 2.9 m but may be three, but reduced due to erosion. Both of these were built in Stage III. The largest one, it seems was re-opened at least thrice, to put offerings. The last one was perhaps in Stage VI. Along with much of pottery offerings, there was a complete necklace of steatite beads strung in a copper wire with hooks at terminals, a gold bangle and some beads of semi-precious stones. Most significantly, such examples in the later Vedic literature were called *sara-ratha-chakra chiti,* meaning an altar made in the fashion of a chariot wheel with spokes. The second one is known as *sapradhi-ratha-chakra chiti,* meaning a chariot

wheel with a felly (only). It is also surmised that these are the earliest forms of later time *stupa* of the historical period.

19. The excavation has yielded enormous quantity of pottery of which the selected ones alone are several wagonloads. A detailed typological and scientific analysis of this pottery can produce at least three doctoral theses. Many mature Harappan elements are present right from the beginning along with non-Harappan ceramics with the types, surface treatment and paintings. It was seen that many of the non-Harappan elements persisted all along through stages up to the last one. Second thing is that Reserved Slip Ware, which is so typical of Gujarat region, was present right from Stage I through VII. Particularly in Stage III, there was proliferation of types and shapes in expertly made fabric, which was very pleasantly decorated with slip and paintings. Such elements also continued at least up to Stage V.

20. The pottery of Stages IV and V have all the manifestations of classical Harappan pottery, alongside local elements which are also very dominant. The bulb that develops at the upper end of stem and below the dish of dish-on-stand was noticed in Stage VI. At other sites, also it comes in late phase. No goblets of pointed base were reported, although those occur profusely in later phase of Harappa civilization at several sites, including Mohenjo-daro and Harappa. Only a couple of black and red ware potsherds of very fine fabric and finish were picked up from Stage IV.

21. The Stage VI pottery is highly inclusive as it not only contain the typical Harappan forms along with slip and painted motifs, but also included exotic wares like black and red ware, black ware and grey ware, sometimes decorated with designs consisting of simple strokes painted in fugitive white. Shapes are simple, and the quantity is not much. Along side appears a new decorative tradition on red ware. Some pots of this class have incised decorations,

applique bands, with incised finger pressed motifs. Besides, there are good examples of Jhukar style pottery. Apart that some goblets are found, the prototypes of which are present in the Bara pottery in eastern part of Harappan territory (Panjab, Haryana).

22. In Stage VII, all ceramic forms and painted motifs of classical Harappan times simply disappear.

23. A solitary seal of steatite, tiny in shape, lighter in weight but bearing a mythological scene, which subsequently became very popular at Harappa and Mohenjo-daro. It has incipient knob with perforation, but it has no inscription, as has been observed on the seals which appears just before the Harappans at Kunal (Haryana), Baror (north Rajasthan), and Mehrgarh (in Balochistan, Pakistan). So far as Stage IV and V are concerned, there is a phenomenal increase in seals of both classical and slightly sub-classical types. Most significantly in Stage VI seals assume a new form which is plano-convex, rectangular face was used for inscriptions and the triangular part being perforated with a hole. There are no motifs at all. It seems that ideology had a paradigm shift. The majority of the seals are not made of steatite, but of kaolinite, indicating that the availability of superior material has stopped.

24. Dholavira has produced about 1000 weights, which outnumber all the weights from other sites put together. Most significant was the fact that the weights had two major series A and B, not related to each other in unit value. Each series has two sub-series, A1, A2, B1 and B2. The former series was hexadecimal in each sub-series, the second one was decimal. The weights were manufactured not only of the normal chert, but also of limestone, sandstone, copper, shell, terracotta, agate, carnelian, chalcedony, and other stones. In particular, the weights of shell and copper were noticed for the first time.

25. The evidence for copper metallurgy is found from Stage I onwards. However, from Stage II evidence of copper smelting is found in the form of numerous examples of slags scattered around the remains of a furnace. Along with this slag, evidence is the presence of terracotta containers in the form of a half-boat. The exact function of this container is not known and those objects are not found from later levels. The proliferation of copper objects is from Stage IV and V, which include a wide variety of objects of all use. The scientific investigations from all the levels indicate the percentage of lead probably indicating the source of copper ore in the Aravalli range in northeast Gujarat and southeast Rajasthan. The evidence of copper working is found from Stage II onwards to Stage VI.

26. The evidence other metals include gold, silver, lead. The Pb isotope analysis of a select lead and silver objects indicate its origin to Balochistan sources, but possibility cannot be ruled out for Gujarat and Rajasthan sources.

27. Another important industry is that of chert blades, which were mostly, produced from the famous Rohri chert sources. The analysis of chert remains from Dholavira indicates exploitation of three other sources as well, including a source in Kalat district of Balochistan. The chert blade industry is a highly developed one with evidences of several cores, fluted cores, chips with evidence of crested ridge technique, several long blades, retouched and broken ones. The evidence indicates a thriving blade manufacturing industry, which was retouched and refashioned to produce various kinds of tools. One such modified tool was a chert drills for making perforations of beads.

28. The lapidary industry is well represented at Dholavira, right from the very beginning. The evidence of at least three lapidary workshops was documented from the excavations, two belonging to Stage VI and one to Stage V. The presence of an enormous quantity of

siliceous materials consisting of agate-carnelian, chalcedony, jasper, of various shades and colours along with nearly 1600 pieces of drill bits of "ernestite" attest to this industry. The analysis of agate-carnelian from Dholavira has pointed to the exploitation of raw material sources of at least three places, Khandik, Mardok and Ratanpur. Although it is reported from many other sites from Kachchh. The presence of raw materials like moss agate in Kachchh is also an indication of future survey and study. The excellent evidence of large number of stone nodules near a furnace from Bagasra clearly indicates the role of such sites in raw material acquisition and distribution. That the role of Dholavira in a larger network of inter-regional and possibly international trade network of agate-carnelian beads cannot be ruled out.

29. Dholavira also played a very crucial role in the production of limestone pillar members. The evidence of a quarry site to the north of Dholavira presenting evidence of removal of limestone blocks, chipping, shaping and finishing along with some incomplete pillar members clearly indicate the exploitation of such sources. The analysis of limestone pillar members from Harappa and Mohenjo-daro clearly indicate that they were produced from the limestone available to the north of Dholavira. That Dholavira played a very crucial role in the production and distribution of limestone pillar members of various shapes to distant sites like Harappa and Mohenjo-daro is well established.

30. Another major industry present at Dholavira was shell working. The presence of a large quantity of raw materials like complete shells of *Turbinela pryum* and *Chicoreus ramosus*, the two most prominent shell species along with other shell species exploited by the Harappans of Gujarat, due to its availability in plenty along the Gulf of Kachchh, sawn and cut shell fragments, columella, debitage, finished and unfinished artefacts like beads, several kinds of inlay designs, bowls, etc., clearly point to the thriving industry at

Dholavira. The evidence also clearly indicates that the shell working is present at the site right from Stage I onwards.

31. Saran was also a very important discovery, alongside the excavation at Dholavira. It was planned in a miniature composite form of Citadel, Stadium and Middle Town.

32. At last it is stressed that the whole city along with its different parts were planned with mathematical precision. It is calculated that the basic unit for measurement is finger (*angula*), measuring 17.6 mm. This clearly indicates the genesis of this unit measurement, which was popular during the historical times, can be easily traced to the Harappan times.

33. From 1995 onwards, a special team was raised for conservation of the exposed remains. Particularly the Castle was given priority because of its monumental architecture, which was quite vulnerable. It is glad to know that it has worked well.

Thus Dholavira epitomises the Harappan Civilization and a metropolitan capital of its southern province, the Harappania.

Future Vision

1. Thousands of visitors, with a good number of international tourists, visit the site every year. It is very popular particularly with the Gujaratis, among the common public and school going children. It makes it imperative that the whole site is scientifically conserved; environmentally developed, basic public amenities provided, movement plan with signage are put in place.

2. An archaeological complex has been built there in 2003 with an information centre, cafeteria, audience hall, besides staying facilities especially for scholars and students. It need upgrading.

3. It is committed to the Parliament to construct a museum of international standard at the site. It still remains a desideratum.

4. The government land falling in the protected area has already been acquired. Now it is need of hour that the problem of private land should be settled by negotiation to preserve the site on the established policies and guidelines. It has been noticed that the owners of private land are damaging the structures, particularly the outer fortification and cemetery.

5. The fields in which researchers for doctoral dissertation should be attracted. In particular, in the following fields:

i) Typological and scientific analysis of pottery
ii) Material characterisation of artefacts
iii) Archaeometallurgy of metals from Dholavira
iv) Environmental and Palaeoclimate Studies
v) Study of sediments of Rann and archaeo-seismology
vi) Analysis of raw materials
vii) Analysis of soil samples
viii) Detailed archaeo-zoological studies
ix) Detailed archaeobotanical studies, particularly on charcoal

Bibliography

Ancient Texts

1. *Atharveda Saṁhitā.* (Sanskrit text) Published in 1994 by Nag Prakashak, 11A. /U.A. Jawahar Nagar, Delhi-110007.Abbr*. AV*

2. *Apastamba Śulba-Praśna* (Sanskrit text). In *The Śulba Sutras: text on the Vedic geometry.*ed. S.S.P. Sarasvati and Usha Jyotiismati. (1979). Dr. Ratn Kumari Svadhyaya Sansthana, Allahabad.

3. *Baudhāyana Śulba-sūtra.* (Sanskrit text)In *The Śulba Sutras: text on the Vedic geometry.*ed. S.S.P. Sarasvati and Usha Jyotiismati. (1979). Dr. Ratn Kumari Svadhyaya Sansthana, Allahabad.

4. *Kātyāyana Śulba-sūtra.* (Sanskrit text) In *The Śulba Sutras: text on the Vedic geometry.*ed S.S.P. Sarasvati and Usha Jyotiismati. (1979). Dr. Ratn Kumari Svadhyaya Sansthana, Allahabad.

5. *Ṛgveda Saṁhitā*. (Sanskrit text) Published in 1996 by Nag Prakashak, 11A /U.A Jawahar Nagar, Delhi-110007. Abbr. *ṚV.*

6. *Yajurveda Saṁhitā*. *(Vājasaneyi-Mādhyandina)* (Sanskrit text). Published in 1997 by Nag Prakashak, 11A. /U.A. Jawahar Nagar, Delhi-110007. Abbr. *YV*

7. *Mānava Śulba-sūtra.* (Sanskrit text) In *The Śulba Sutras: text on the Vedic geometry.*ed S.S.P. Sarasvati and Usha Jyotiismati. (1979). Dr. Ratn Kumari Svadhyaya Sansthana, Allahabad.

8. *Maitrāyaṇī-saṁhitā*. (Sanskrit text), ed. Shripad Damodar Satvalekar, Svadhyaya Mandal, Pardi (Balsad). Gujarat.

9. *Taittiriya-saṁhitā* (Sanskrit text), ed. Shripad Damodar Satvalekar, Svadhyaya Mandal, Pardi (Balsad), Gujarat. (1957)

10. *Śatapatha-brāhmaṇa.* (Eng. trans.),by Julius Eggeling. In Sacred Books of East Series. Part-I-V (reprint 1996, 2001, 02, 04). Motilal Banarasidas Publishers Pvt. Ltd., Delhi-110006. Abbr. *ŚB*

11. *Vājasaneyī-saṁhitā* (Sanskrit text). ed. Vasudeva Lakshamana Shastri. Niryansagar Press, Bombay. (1929). Abbr. *VS*

Modern Works

1. Acharya, P. K. (1979). *Hindu Architecture in India and Abroad*. Manasara series: vol. VI. 2nd ed. Oriental Books Reprint Corporation, 54 Rani Jhansi Road, New Delhi-110055.

2. Agrawal, D.P. (1984) Metal Technology of the Harappans, in *Frontiers of the Indus Civilization*, edited by B.B. Lal and S.P. Gupta, Delhi: Books and Books, 163-167

3. Alcock, L., (1986) A Pottery Sequence from Mohenjo Daro: R.E.M. Wheeler’s 1950 “Citadel Mound” excavations, in Dales, G.F., and Kenoyer, J.M., *Excavations at Mohenjo Daro*, Pakistan: The Pottery, Philadelphia, 493-551

4. Allchin, F.R. and Knox, R., Preliminary Report on the Excavations at Lewan, 1977-78, *South Asian Archaeology* 1979, Berlin, 241-244.

5. Asthana, Shashi (1985) *Pre-Harappan Cultures of India and the Borderlands,* Delhi, Books and Books

6. Barthelemy de Saizieu, B and Rodiere, J (2005) Bead-Drilling: A Look from Mehrgarh and Nausharo. Preliminary Analysis of Micro-trace Analysis, *South Asian Archaeology* 2003, pp. 39-48.

7. Barthelemy de Saizieu, B. and A Bouquillon, "Evolution of Glazed Material from the Chalcolithic to the Indus period based on the date of Mehrgarh and Nausharo", in "South Asian Archaeology 1995", edited by Raymond and Bridget Allchin, pp. 63 – 76, Oxford and IBH Publication, New Delhi, 1997

8. Besenval, M.R. and Marquis, P., (1993) Excavations in Miri Qalat (Pakistani Makran) – results of the First Field Season (1990), South Asian Archaeology 1991, 31-48

9. Besenval, M.R., (1992) Recent Archaeological Surveys in Pakistani Makran, South Asian Archaeology 1989, Monographs in World Archaeology, 14: 25-35

10. Besenval, M.R., (1994) The 1992-1993 field seasons at Miri Qalat: New Contributions to the Chronology of Protohistoric Settlement in Pakistani Makran, South Asian Archaeology 1993, 81-91

11. Besenval, R., Marcon, V., Buquet, C., and Mutin, B., (2005) Shahi-Tump: Results of the Last Field Seasons (2001-2003), South Asian Archaeology 2003, 49-56.

12. Besenval, Ronald 2011. Between East and West: Kech-Makran (Pakistan). In, Central Relations between the Indus and the Iranian Plateau during the third millennium BCE, eds. T.Osada and Michael Witzel, Indus Project, Research Institute for Humanities and Nature, June 7-8, 2008, Department of South Asian Studies, Harvard University, Cambridge, Messachusetts, 41-164.

13. Betekhtim, A. (n.d.), A Course of Mineralogy, tran. from the Russian by V.Agol.Moscow Peace Publishers, 576,419).

14. Bhan, K.K., (1989) Late Harappan Settlements of Western India, with Special Reference to Gujarat in Old Problems and New Perspectives in the Archaeological of South Asia, edited by Kenoyer, J.M., Wisconsin Archaeological Reports, Madison, 2: 219-242

15. Bhan, S., (1975) Excavation at Mitathal (1968) and Other Explorations in the Sutlej-Yamuna Divide, Kurukshetra: Kurukshetra University.

16. Bisht, R.S. (1991). Dholavira: New Horizons of the Indus Civilization. In *Purātattva, No. 20*. New Delhi: pp. 71-82.

17. Bisht, R.S. (1997). Dholavira Excavations: 1990-94. In *Facets of Indian Civilization-Essays in, Honour of Prof. B. B. Lal*, ed. J.P. Joshi, vol. I. New Delhi: Aryan Books International: pp. 107–120.

18. Bisht, R.S. (1999). Dholavira and Banawali: Two different paradigms of the Harappan urbis forma. In *Purātattva,* No. 29: pp. 14-37.

19. Bisht, R.S. (2000). Urban Planning at Dholavira: a Harappan City, in *Ancient Cities, Sacred Skies: Cosmic Geometries and City Planning in Ancient India.*eds. J. McKim Malville & Lalit M. Gujral. New Delhi: Indira Gandhi National Centre for the Arts & Aryan Books International: pp. 11–23.

20. Bisht, R.S. (2001). Indus Civilization-last fifty Years of the Study in India. In *Indus Civilization*. NHK Publication, Japan: pp. 26-28.

21. Bisht, R.S. (2005). The Water Structures and Engineering of the Harappans at Dholavira (India). In *South Asian Archaeology* 2001*,* vol. 1. (eds. Catherine Jarrige & Vincent Lefèvre, Editions Research sur les Civilisations, Paris: pp. 11-25.

22. Blackman, J.M. and Vidale, M., (1992) The Production and Distribution of Stonware Bangles at Mohenjo-daro and Harappa as Monitored by Chemical Characterization Studies, in Catherine Jarrige (ed.) South Asian Archaeology 1989, Monographs in World Archaeology N0. 14, Prehistory Press, Madison.

23. Burnes, Alexander (1835) Memoir on the eastern branch of the River Indus. *Transactions of the Royal Asiatic Society*, 3: 33

24. Casal, J.M., (1964) *Fouilles d' Amri*, 2 Vol, Paris: Puublications de la Commission des Fouilles Archaeologiques, Fouilles du Pakistan, 1: 57-65

25. Casal, J.M., (1966) Nindowari-A Chalcolithic Site in South Baluchistan, Pakistan Archaeology, 3: 10-21.

26. Chakrabarti, DK., (1978) Reserved Slip Ware in the Harappan Context, *Puratattva*, 8: 158-164

27. Chakrabarti, DK., (1978) The Nippur Indus Seal and Indus Chronology, Man and Environment, 2: 88-90

28. Chakrabarti, DK., (1979) Size of Harappan Settlements, in Essays in Indian Protohistory, eds. D.P. Agrawal and Dilip Chakrabarti, Delhi, 205-215

29. Chitalwala, Y.M., 1982, Harappan Settlements in the Kutch-Saurashtra Region.Harappan Civilization. G. L. Posehl, ed. Pp. 197-202. New Delhi : Oxford and IBH Publishing co.

30. Cholidis, Nadja 2003. Bead naming Mesanpada (cat. no. 84). In Art of the first cities; the third millennium B.C. from the Mediterranean to the Indus, The Metropolitan Museum of Art, New York, Yale University Press, New Haven and London.

31. Cleuziou, Serge and Maurizio Tosi, 2007. In the shadow of the ancestors: The prehistoric foundations of the early Arabian Civilization in Oman. Ministry of Heritage and culture, Sultanate of Oman, 19-31

32. Collins, Paul, 2003, ‘Double – spiral pendant’ and ‘Strings of beads with quadruple – spiral pendant, ‘In Art of the first cities; the third millennium B.C. from the Mediterranean to the Indus, The Metropolitan Museum of Art, New York, Yale University press, New Haven and London, 129-30, cat. nos. 77-78.

33. Collins, Paul, 2003, ‘String of beads’. In Art of the first cities; the third millennium B.C. from the Mediterranean to the Indus, The Metropolitan Museum of Art, New York, Yale University press, New Haven and London. 233, cat. no. 159.

34. Collins, Paul, 2003, Strings of etched carnelian and other beads. In Art of the first cities; the third millennium B.C. from the Mediterranean to the Indus, ed. Joan Aruz, the Metropolitian Musuem of Art, Yale university press, New Haven and London 130-31.

35. Coningham, R., (1997) The Indo-Aryans of Ancient South Asia: Language, Material Culture and Ethnicity, Antiquity 71, 249-251

36. Conrad, R., (1974) The Domestic Animals in the Early Cultures of India, Puratattva, 7: 76-77.

37. Crawford, H.E.W., (1973) Mesopotamia’s Invisible Exports in the Third Millennium B.C., World Archaeology, Vol. 5, No. 2, Trade, 232-241

38. Cunningham, A., (1875) Harappa, Annual Report of the Archaeological Survey of India, 5: 105-108.

39. Dales, G.F. 1979. The Balakot project: Summary of four years of excavation in Pakistan. Man and Environment 3:45-53.

40. Dales, G.F. and C.P. Lipo, 1992. Explorations on the Makran coast, Pakistan : A search for paradise. Contributions of the Archaeological research Faculty, University of California, No. 50 Berkelay.

41. Dales, G.F., "The Balakot Project: Summary of Four Years of Excavations in Pakistan", in "South Asian Archaeology 1977", edited by M. Taddei, pp. 241 – 274, Naples, 1979.

42. Dales, G.F., (1965) New Investigations at Mohenjo-daro, Archaeology, 18: 145-150.

43. Dales, G.F., (1966) The Decline of the Harappans, Scientific American, 214(5): 93-100.

44. Dales, G.F., (1968) A Review of the Chronology of Afghanistan, Baluchistan and Indus Valley, American Journal of Archaeology, Volume 72, Issue 4,305-307

45. Dales, G.F., (1968) Of Dice and Men, Journal of the American Oriental Society, Volume 88, Issue 1, 14-23.

46. Dales, G.F., (1974) Excavations at Balakot, Pakistan 1973, Journal of Field Archaeology, 1: 3-22.

47. Dales, G.F., and J.M. Kenoyer (1986) Excavations at Mohenjo Daro, Pakistan: The pottery. Philadelphia: The University Museum, University of Pennsylvania.

48. Dales, George. F., J. Mark Kenoyer and et al. (1991).Summaries of five seasons of research at Harappa (District Sahiwal, Punjab, Pakistan), 1986-1990. In Harappan Excavations 1986-1990: A Multidisciplinary Approach to Third Millennium Urbanism, (ed.) Richard H. Meadow, Monographs in World Archaeology No.3, Prehistory Press, Madison, Wisconsin: pp.185-262.

49. Datta, J.M., (1962) Demographic Notes on Harappa Skeletons, in Gupta, P., Dutta, P.C., and Basu, A., Human Skeletal Remains from Harappa, Memoirs of the Anthropological Survey of India, 9: 7-12.

50. Deshpande-Mukherjee and Vasant Shinde 2014 Evaluating the role of Molluscan Shell assemblage recovered from Padri, a Coastal Harappan settlement in Gujarat, India. In Archaeomalacology: Shells in the Archaeological Record. Proceedings of the 11th ICAZ International Conference. Paris - Archaeomalacology Working group, 23-28 August 2010, France SzaboK., Dupont C., Dimitrijevic V., Gastelum Gomez L.G., Serrand N., (eds.), 19-31. -, BAR International Series 2666. Archaeopress, Oxford, ISBN 978 1 4073 1308 5.

51. Deshpande-Mukherjee, A, Soumi Sengupta.and Jitendra Nath (in press) The Molluscan Shell assemblage from Khirsara: Evidence for another Harappan shell working settlement in Gujarat. (accepted in the Heritage : Multidisciplinary Journal of Archaeology.

52. Deshpande-Mukherjee, A. 1998. Shell fishing and shell craft activities during the Harappan period in Gujarat. Man and Environment Vol XXXIII (1): 63-81.

53. Deshpande-Mukherjee, A. 1999. A preliminary study of Marine molluscan shell remains from Bagasra: A Harappan site in Gujarat. Puratattva 29: 110-113.

54. Deshpande-Mukherjee, A. 2006. Reconstructing the past: Ethnographic Observations on Shell working at Bishnupur.in Past and Present Ethnoarchaeology in India.(Gautam Sengupta, Suchira Roychoudhary and Sujit Som eds), pp.383-409, Pragati Publications, N.Delhi and Centre for Advanced Studies and Training in Eastern India, Kolkata.

55. Deshpande, A. 1996-97. Application of Molluscan Studies in Archaeology with Special Reference to Western India (Ph.D. synopsis). Bulletin of the Deccan College Post-graduate and Research Institute 56-57: 355-361.

56. Deshpande, A. 1996. Shell Remains. In Kuntasi, a Harappan emporium on West Coast. (M. K. Dhavalikar, M. R. Raval and Y. M. Chitalwala, eds.), pp. 331-347. Pune: Deccan College.

57. Dhavalikar, M.K., (1982) Daimabad Bronzes, in Harappan Civilization: A Contemporary Perspective, ed., Possehl, G.L., Delhi, 361-366.

58. Dhavalikar, M.K., (1992) Kuntasi: An Harappan Port in Western India, South Asian Archaeology 1989, Monographs in World Archaeology 14: 73-82.

59. Dhavalikar, M.K., and Possehl, G.L., (1992) The Pre-harappan Period at Prabhas Patan and the Pre-Harappan Phase in Gujarat, Man and Environment, 17(1): 71-78.

60. Dikshit, K.N., (1980) A Critical Review of the Pre-Harappan Cultures, Man and Environment, 4: 32-43.

61. Dikshit, K.N., (1981) The Excavations at Hulas and Further Exploration of the Upper Ganga-Yamuna Doab, Man and Environment, 5: 70-76.

62. Dikshit, K.N., (1984) The Sothi Complex: Old Records and Fresh Observations, in Frontiers of the Indus Civilization, eds., Lal. B.B., and Gupta, S.P., Delhi, 51-537.

63. Dikshit, M.G., (1950) Excavations at Rangpur: 1947, Bulletin of the Deccan College Research Institute, 11(1): 3-55.

64. During-Caspers, E.C.L., "Vanity Portrayed in Clay: the Female terracotta figurines from Harappa" in "South Asian Archaeology 1993", edited by Asko Parpola and Petteri Koskikallio, pp. 183 - 191, Helsinki, 1994.

65. Durrani, F.A., Ali, I., and Erdosy, G., (1991) Further Excavations at Rehman Dheri, Ancient Pakistan, 7: 61-151.

66. Eggeling, Julius (2002. *reprint*). *Śatapatha-brāhmaṇa.* Part-I-V. In The Sacred Book of East Series.

67. Fairservis, Jr., W.A., (1956), The Chronology of the Harappan Civilization and the Aryan Invasions: Recent Archaeological Research, Man, Volume 56, 153-156

68. Fairservis, W.A. Jr., (1975) The Roots of Ancient India, University of Chicago Press, Chicago.

69. Fairservis, W.A., Jr., "Allahdino: An Excavation of a Small Harappan Site", in "Harappan Civilization: A Recent Perspective" edited by G.L. Possehl, Second Revised Edition, pp. 107 – 112, 1993.

70. Fairservis, W.A., Jr., "The Roots of Ancient India", revised 2nd Edition,

Chicago University Press, 1975.

71. Francfort, H.P. (1983), Excavations at Shortugai in Northeast Afghanistan, American Journal of Archaeology, Vol. 87 (4), October 1983, pp. 518-519.

72. Francfort, Henry-Paul 1989. Fouilles de Shortughai researches sur L'Asie Central protohistorique, vol I. Diffusion de Boccard II, rue de Médicis, 75006 Paris.

73. Gadd, C.J. and Smith, S. (1924), The New Links between Indian and Babylonian Civilization, Illustrated London News, 4th October, 1924, pp. 614-616.

74. Gaur, A. S., Sundaresh and K. H. Vora 2005. Archaeology of Bet Dwarka Island. New Delhi: Aryan Books International and National Institute of Oceanography, Dona Paula.

75. Gazetteer of India, 1971, Gujarat State, Kutch District, Ahmedabad.

76. Geology and Mineral Resources of Gujarat, Daman & Diu, (2001) Geological Survey of India, Miscellaneous Publication, No. 30, Part IV.

77. Geology and Mineral Resources of of Rajasthan, (20110 Geological Survey of India, Miscellaneous Publication, No. 30, Part 12

78. Ghosh, A., (1965) The Indus Civilization: Its Origins, Authors, Extent and Chronology, in Indian Prehistory: 1964, eds., Mishra V.N., and Mate, M.S., Deccan College Post-Graduate and Research Institute, Poona, 113-124.

79. Gupta, S.P., "The Indus-Saraswati Civilization", Pratibha Prakashan, Delhi, 1996.

80. Halim, M.A., (1972) Excavation at Sarai Khola, Part I, Pakistan Archaeology, 7: 23-89.

81. Halim, M.A., and Vidale, M., (1983) Kilns, Bangles and Coated Vessels: Ceramic Production in Closed Containers at Moenjodaro, Reports on Field Work Carried out at Mohenjodaro, Pakistan 1982-83 by the Is MEO-Aachen University Mission: Interim Reports, Vol. I, ed., Jansen, M., and Urban, G., 63-97

82. Halim, M.A., and Vidale, M., (1987) Kilns, Bangles and Coated Vessels: Ceramic Production in Closed Containers at Mohenjo-daro, in M. Jansen and G. Urban (eds.) Interim Reports Vol. I, Reports on the Fieldwork carried out at Mohenjo-daro, IsMEO-Achen University Mission.

83. Hashimi, N.H., (1995) Holocene Sea Level Fluctuations on Western Indian Continental Margin: An Update. Journal Geological Society of India Vol. 46: 157-162.

84. Hegde, K.T. M, K. K. Bhan, V. H. Sonawane, K. Krishnan and D. R. Shah 1992. Excavations at Nageshwar: a Harappan shell working site on the Gulf of Kutch. Vadodara: M.S. University Archaeological Series

18.

85. Hegde, K.T. M, K. K. Bhan, V. H. Sonawane, K. Krishnan and D. R. Shah 1992. Excavations at Nageshwar: a Harappan shell working site on the Gulf of Kutch. Vadodara: M.S. University Archaeological Series 18.

86. Hegde, K.T.M., Bhan, K.K., and Sonawane, V.H., (1984-85) Excavations at Nageshwar-1984: A Preliminary Report, Journal of the Maharaja Sayajirao University of Baroda (Humanities), 33-34(1): 3-12.

87. Hegde, K.T.M., Karanth, R.V., and Sychanthavong, S.P., (1982) On the Composition and Technology of Harappan Microbeads, Harappan Civilization: A Contemporary Perspective, ed., Possehl, G.L., 239-244

88. Hegde, K.T.M., Sonawane, V.H., Shah, D.R., Bhan, K.K., Ajith Prasad, Krishnan, K., and Pratapa Chandran, A., (1988) Excavation at Nagwada-1986 and 1987: A Preliminary Report, Man and Environment, 12: 55-65.

89. Hemmy, A.S., (1931) System of Weights at Mohenjo-daro being Chapter XXIX in John Marshall (ed) Mohenjo-daro and Indus Civilization: Being an official account of Archaeological Excavaion at Mohenjo-daro carried out by the Government of India between 1922 and 1927, Arthur Probsthain, pp. 589-598.

90. Hemmy, A.S., (1931) System of Weights at Mohenjo-daro, in Mohenjo-daro and the Indus Civilization, 3 Vols., ed. Sir John Marshall, London, 589-98.

91. Hemmy, A.S., (1937-38) System of Weights at Mohenjo-daro, in Further Excavations at Mohenjo-daro, ed. Ernest J.H. Mackay, Delhi, 601-612.

92. Hemmy, A.S., (1943) Weights at Chanhu-daro being Chapter XV in Ernest J.H. Machay (ed.) Chanhu-daro Excavations 1935-36, American Oriental Society, New Haven, 1944, pp. 236-246.

93. Hemphill, Brian E., John R. Lukacs and K.A.R. Kennedy (1991). Biological adaptations and affinities of Bronze Age Harappans. In Harappan *Excavations 1986-1990: A Multidisciplinary Approach to Third Millennium Urbanism*, (ed.) Richard H. Meadow, Monographs in World Archaeology No.3, Prehistory Press, Madison, Wisconsin: pp.137-182.

94. Hiebert, F.T. and C.C. Lamberg-Karlovsky, "Central Asia and the Indo-Iranian Borderlands" in "Iran" No. 30, pp. 1 – 15, 1992

95. *Indian Archaeology – A Review* for the years 1989-90 to 1999-2000, Archaeological Survey of India, Government of India, New Delhi

96. *Indian Archaeology 1970-71 - A Review*, Archaeological Survey of India, Govt. of India, New Delhi, 1974.

97. Jansen, M., (1981) Settlement Patterns in the Harappa Culture, South Asian Archaeology 1979, 251-269.

98. Jarrige, C., "The Figurines from Nausharo Period I and their further Developments" in "South Asian Archaeology 1995", edited by Raymond and Bridget Allchin, pp. 33 – 43, Oxford and IBH Publications, New Delhi, 1997

99. Jarrige, C., "The Mature Indus Phase at Nausharo as seen from a block of Period III" in "South Asian Archaeology 1993", edited by Asko Parpola and Petteri Koskikallio, pp. 281 – 294, Helsinki, 1994.

100. Jarrige, C., (2005) Human Figurines from the Neolithic Levels at Mehrgarh (Balochistan, Pakistan), South Asian Archaeology 2003, 27-37.

101. Jarrige, C., Jarrige, J-F., Meadow, R. H., Quivron, G., (1995) Mehrgarh: Field Reports 1974-1985, From Neolithic Times to the Indus Civilization, Government of Pakistan.

102. Jarrige, J-E, C. Jarrige & G. Quiron 2001. Mehrgarh Neolithic: The updated sequence. In South Asian Archaeology 2001, vol. I eds. C. Jarrige and V. Lefevre, Prehistory, Editions Research sur leh civilizations, Ministere des Affaires Estrangeres, Direction Generale de la Cooperation International et du Development Sans-directions des Sciences Sociades et de, Archeologie, 6, rue ferrus 75683 Paris, 139, fig 10.

103. Jarrige, J.F., "Continuity and Change in the North Kachi Plain (Baluchistan, Pakistan) at the beginning of the second Millennium BC" in "South Asian Archaeology 1983", edited by J. Schotsmans and M. Taddei, pp. 35 – 68, Naples, 1985

104. Jarrige, J.F., (1979) Excavations at Mehrgarh-Pakistan, South Asian Archaeology 1975, Leiden, 76-87.

105. Jarrige, J.F., (1981) Economy and Society in the Early Chalcolithic / Bronze Age of Baluchistan: New Perspectives from Recent Excavations at Mehrgarh, South Asian Archaeology 1979, Berlin, 93-114.

106. Jarrige, J.F., (1982) Excavations at Mehrgarh: Their Significance for Understanding the Background of the Harappan Civilization, in Harappan Civilization: A Contemporary Perspective, ed., Possehl, G.L., Delhi, 79-84.

107. Jarrige, J.F., (1984) Chronology of the Earlier Periods of the Greater Indus as seen from Mehrgarh, Pakistan, South Asian Archaeology 1981, Cambridge, 21-29.

108. Jarrige, J.F., (1986) Excavations at Mehrgarh-Nausharo, Pakistan Archaeology, 10-22: 63-131.

109. Jarrige, J.F., (1988) Excavation at Nausharo, Pakistan Archaeology, 23: 149-203.

110. Jarrige, J.F., (1993) The Question of the Beginnings of the Mature Harappan Civilization as seen from Nausharo Excavations, South Asian

Archaeology 1991, Stuttgart, 149-164.

111. Jarrige, J.F., (1994) The Final Phase of Indus Occupation at Nausharo and its Connection with the Following Cultural Complex at Mehrgarh VIII, South Asian Archaeology 1993, Helsinki, 295-313.

112. Joshi, J.P. (1993), Excavation at Bhagwanpura 1975-76 and Other Explorations and Excavations 1975-81 in Haryana, Jammu & Kashmir and Punjab, Memoirs of the Archaeological Survey of India 89, Delhi.

113. Joshi, J.P., (1990) Excavation at Surkotada 1971-72 and Exploration in Kutch, Memoirs of the Archaeological Survey of India, 87.

114. Joshi, Jagat Pati. (1990). Excavation at Surkotada 1971-72 and Exploration in Kutch. *Memoirs of the Archaeological Survey of India No. 87.* VAP Enterprises, H-24, Green Park Extension, New Delhi-110016.

115. Kaul, S.B. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain

116. Kennedy, K.A.R., and Caldwell, P.C., (1984) South Asian Prehistoric Human Skeletal Remains and Burial Practices, in The People of South Asia: The Biological Anthropology of India, Pakistan and Nepal, ed., Lukacs, J.R., New York, 159-97.

117. Kenoyer, J. M. 1984. Shell working Industries of the Indus Civilisation: a summary. Palaeorient 10 (1): 49-63.

118. Kenoyer, J.M. (1991) Ornament Styles of the Indus Valley Tradition: Evidence from Recent Excavations at Harappa, Pakistan, Palaeorient 17/2, pp. 79-98.

119. Kenoyer, J.M. (1991), The Indus Valley Tradition of Pakistan and Western India, Journal of World Prehistory, Vol. 5(4), pp. 331-375.

120. Kenoyer, J.M. (2003) Uncovering the Keys to the Lost Indus Cities, Scientific American, p. 73.

121. Kenoyer, J.M. 1995. Shell trade and shell working during the Neolithic and Early Chalcolithic at Mehrgarh, Pakistan. In Mehrgarh : Field reports 1974-1985-from Neolithic times to the Indus civilization, eds. C. Jarrige, J-F. Jarrige, R.H. Meadow &G. Quivron. The Department of Culture and Tourism, Govt. of Sindh, Pakistan, in collaboration with the French Ministry of Foreign Affairs, 566-81.

122. Kenoyer, J.M., "Ancient Cities of the Indus Valley Civilization", Oxford University Press, Oxford, New York, Delhi, 1998.

123. Kenoyer, J.M., ed., "Old Problems and New Perspectives in the Archaeology of South Asia", Wisconsin Archaeological Reports 2, Madison, 1989.

124. Khan, F.A., (1965) Excavations at Kot Diji, Pakistan Archaeology, 2: 11-85.

125. Kharakwal, J.S., Y.S. Rawat and Toshiki Osada 2012. Excavations at Kanmer 2005-06-2008-09 Indus Research Project Institute for Humanity and Nature, Kyoto, Japan.

126. Krishna Deva and McCown, D.E., (1949) Further Exploration in Sindh: 1938, Ancient India, 5: 12-30.

127. Krishna, D.B. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain.

128. Lal, B.B. (1978), Kalibangan and the Indus Civilization, In Agrawal, D.P., and Chakrabarti, D.K., (eds.), Essays in Indian Protohistory, Delhi, pp. 65-97

129. Lal, B.B. and S.P. Gupta, "Frontiers of the Indus Civilization", New Delhi, 1984.

130. Lal, B.B., (1979) Kalibangan and Indus Civilization, in Essays in Indian Protohistory, eds., Agrawal, D.P., and Chakrabarti, D., Delhi, 65-97.

131. Lal, B.B., (1997) "The Earliest Civilization of South Asia", Aryan Books International, New Delhi.

132. Lamberg-Karlovsky, C.C., "The Indus Civilization: the Case for Caste Formation", Brill, Leiden, 1999

133. Lamberg-Karlovsky, C.C., "The Oxus Civilization: the Bronze Age of Central Asia" in "Antiquity" No. 68 (Special Section), edited by C.C. Lamberg-Karlovsky, pp. 253 – 427, 1994

134. Langdon, S.H., (1931) The Indus Script, in Mohenjo-daro and the Indus Civilization, ed., Sir John Marshall, 3 Vols., London, 423-455.

135. Law, R. (2005), A Diachronic Examination of Lithic Exchange Networks during the Urban Transformation of Harappa, South Asian Archaeology 2003, pp. 111-122.

136. Law, R., (2011) Inter-Regional Interaction and Urbanism in the Ancient Indus Valley: A Geologicl Provenience Study of Harappa's Rock and Mineral Assemblage, Reseasrch Institute for Humanty and Nature, Kyoto, Japan.

137. Mackay, E.J.H. (1976). *Chanhudaro Excavations: 1935-36.* Bharatiya Publishing House, B9/45, Pilkhana, Sonarpur, Varanasi.

138. Mackay, E.J.H., 1938. Further excavation at Mohenjo-daro. Archaeological Survey of India, New Delhi.

139. Madhav Sarup Vats (1999) Excavations at Harappa: Being an account of Archaeological Excavations at Harappa carried out between the years 1920-21 and 1933-34, Archaeological Sruvey fo India, New Delhi (rep.)

140. Maekawa, Kazuya and Wakaha Mori 2011, Dilmun, Magan and Meluhha: Central Relations between the Indus and the Iranian Plateau during the third millennium BCE. Indus Project, Research Institute for

Humanities and Nature, June7-8, 2008, Department of South Asian Studies, Harvard University, Cambridge, Messachusetts.

141. Mahadevan, I., (1977) The Indus Script: Texts, Concordance and Tables, Memoirs of the Archaeological Survey of India, 77.

142. Marshall, J. (1924), First Light on a Long Forgotten Civilization, Illustrated London News, 20th September, 1924, pp. 538-42.

143. Marshall, J., (1920-21) Harappa, Annual Reports of the Archaeological Survey of India, 1920-21: 15-17.

144. Marshall, J., (1923-24) Exploration and Research, Harappa and Mohenjo-daro, Annual Reports of the Archaeological Survey of India, 1923-24: 47-51

145. Marshall, J., (1928) A New Chapter in Indian Archaeology, Illustrated London News, 14 January: 42-45.

146. Marshall, J., (1928) A New Chapter in Indian Archaeology,Illustrated London News, 7 January: 12-15.

147. Marshall, J., (1931) Mohenjo-Daro and the Indus Civilization, London

148. Masson, Charles (1843) Narrative of various Journey in Baluchistan, Afghanistan the Punjab and Kalat, Including on Account of the Insurrection in that place in 1840 and a Memoir of Eastern Balochistan. 4 Vols. London: Richard Bently.

149. Maurya, D.M., Thakkar, M.G., Patidar, A.K., S. Bhandari, Goyal, B., Chamyal, L.S., (2008) Late quaternary geomorphic evolution of the Coastal zone of Kachchh, Western India. Journal of Coastal Research 24, 746-758.

150. Meadow, R.H. 1989. Continuity and change in the Greater Indus Valley: the palaeoethnobotanical and zooarchaeological evidence, pp. 61- 74, in Old Problems and New Perspectives in the Archaeology of South Asia, J .M. Kenoyer, ed., Wisconsin Archaeological Reports 2, Madison, Wisconsin.

151. Meadow, R.H. 1991. Faunal remains and urbanism at Harappa, pp. 89-106, in Harappa Excavations 1986-1990: a Multidisciplinary Approach to Third Millennium Urbanism, R.H. Meadow, ed., Prehistory Press, Madison, Wisconsin.

152. Meadow, R.H., (1979) Prehistoric Subsistence at Balakot: Initial Consideration of the Faunal Remains, South Asian Archaeology 1977, 275-315.

153. Meadow, R.H., (1981) Early Animal Domestication in South Asia: A First Report of the Faunal Remains from Mehrgarh, Pakistan, South Asian Archaeology 1979, 143-179.

154. Meadow, Richard H. and Jonathan Mark Kenoyer, (1994) "Harappa Excavations 1993: City walls and inscribed materials" in "South Asian

Archaeology 1993" edited by Asko Parpola and Petteri Koskikallio, pp. 451 – 470, Helsinki.

155. Meadow, Richard H. and Jonathan Mark Kenoyer, (1997) "Excavations at Harappa 1994 – 1995: New Perspectives on Script, Craft activities and city organization" in "South Asian Archaeology 1995", pp. 139 – 172.

156. Mery, S. (1996), Ceramics and Patterns of Exchange Across the Arabian Sea and the Persian Gulf in the Early Bronze Age, Colloquia XXXII, pp. 167-179

157. Mery, Sophie and M. James Blackman 2001. ‘‘Socio-economical patterns of a ceramic container: the Harappan black slipped jar.’’ In South Asian Archaeology 2011.

158. Mery, Sophie, 2007. Indian pottery in Oman. In In the shadow of the ancestors: The prehistoric foundations of the early Arabian Civilization in Oman. Ministry of Heritage and culture, Sultanate of Oman, 199-201.

159. Mery, Sophie, and James Blackman, 2005. Socio-economic patterns of a ceramic container : the Harappan black slipped jar. In South Asian Archaeology 2001, eds. Catherine Jarriage, In South Asian Archaeology 2001, Curzon Press Ltd, London 227-35.

160. Misra, V.N., (1984) Climate, a Factor in the Rise and Fall of the Indus Civilization-Evidence from Rajasthan and Beyond, in Frontiers of the Indus Civilization, eds., Lal, B.B., and Gupta, S.P., 461-489.

161. Mughal, M.R., "Jhukar and the Late Harappan Cultural Mosaic of the Greater Indus Valley" in "South Asian Archaeology 1989" edited by C. Jarrige, pp. 213 – 221, Prehistory Press, Madison, Wisconsin, 1992

162. Mughal, M.R., "The Decline of the Indus Civilization and the Late Harappan Period in the Indus Valley" in "Lahore Museum Bulletin", No. 3 (2), pp. 1 – 17, 1990

163. Mughal, M.R., "The Rise of Indus Civilization", in "Forgotten Cities on the Indus" edited by M. Jansen, M. Mulloy and G. Urban, pp. 104 – 110, Phillip Von Zabern, Maniz, Germany, 1991.

164. Mughal, M.R., (1968) Excavations: Harappa, 1966 (Cemetery R-37), Pakistan Archaeology, 5: 63-68.

165. Mughal, M.R., (1992) Jhukar and the Late Harappan Cultural Mosaic of the Greater Indus Valley, South Asian Archaeology 1989, 213-222.

166. Mughal, M.R., (1997) Ancient Cholistan: Archaeology and Architecture, Lahore.

167. Nath, Amarendra. (1998) Rakhigarhi: A Harappan Metropolis in Saraswati-Drishadvati Divide. *Purātattva:* 28: pp. 41-43.

168. Nath, Amarendra. (1998) Rakhigarhi: A Harappan Metropolis in

Saraswati-Drishadvati Divide. Purātattva: 28: pp. 41-43.

169. Nath, Bhola (1963) Animal Remains from Rangpur, in S.R. Rao, Excavations at Rangpur and Other Explorations in Gujarat, Ancient India, 18-19: 153-160

170. Nath, Bhola (1968) Animal Remains from Rupar and Bara Sites, Ambala District, East Punjab, Indian Museum Bulletin, 3(1-2), 69-115

171. Nath, J, R.N. Kumaran and Amol Kulkarni 2012. Excavations at Khirsara: A Harappan out post in Kachchh. Puratattva 42: 122-132.

172. NHK Catalogue (2000), Indus Civilization Exhibition

173. Pandya, Suman Ban, 1982, Kotado—A Major Urban Settlement in Greater Rann of Kutch. Indian Archaeology—New Persectives. R.K. Sharna, pp. 127-30, Delhi : Agam Prakashan.

174. Parpola, A., "Deciphering the Indus Script", Cambridge University Press, Cambridge, 1993.

175. Patil, C.S. (1991). Madinat Hamad: burial mounds-1984-85. Bahrain National Museum, Ministry of Information, State of Bahrain.

176. Patil, C.S. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain.

177. Piggot, Stuart, (1950) "Prehistoric India", Penguin, London.

178. Possehl, G.L. (1996), Meluhha, The Indian Ocean in Antiquity, pp. 133-208.

179. Possehl, G.L. (1997), Seafaring Merchants of Meluhha, South Asian Archaeology 1995, pp. 87-100.

180. Possehl, G.L. (1999), The Transformation of the Indus Civilization, Man and Environment XXIV(2), pp. 1-33.

181. Possehl, G.L. (2002), Indus-Mesopotamian Trade: The Record in the Indus, Extrait d'Iranica Antiqua, Vol. XXXVII, pp. 326-342.

182. Possehl, G.L. and D.P. Mehta, (1994) "Excavations at Rojdi, 1992 – 93" in "South Asian Archaeology 1993", edited by Asko Parpola and Petteri Koskikallio, pp. 603 - 614, Helsinki, 1994.

183. Possehl, G.L., "Ancient Cities of the Indus", Vikas Publishing House, New Delhi, 1979.

184. Possehl, G.L., "Conclusions: the Early Harappan Stage, a prelude to Civilization?", in "Indus Age: The Beginnings" by G.L. Possehl, pp. 713 – 725, Oxford and IBH, New Delhi, 1999.

185. Possehl, G.L., "Harappan Civilization: a Recent Perspective", Oxford and IBH Publications, New Delhi, 1993.

186. Possehl, G.L., "Indus Age; The Beginnings", Oxford and IBH Publishing,

New Delhi, 1999.

187. Possehl, G.L., (1981) Cambay Beadmaking: An Ancient Craft in Modern India, Expedition (Summer 1981), pp. 39-47.

188. Possehl, G.L., (1982) Discovering Ancient India's Earliest Cities: The First Phase of Research, in Harappan Civilization: A Contemporary Perspective, ed., Possehl, G.L., 405-413.

189. Possehl, G.L., (1988) Radiocarbon Dates from South Asia, Man and Environment, 12: 169-196.

190. Possehl, G.L., (1994) Excavations at Rojdi 1992-93, South Asian Archaeology 1993, 603-614.

191. Possehl, Gregory L. (2002). *The Indus Civilization: a contemporary perspective.* A Division of Rowman & Littlefield Publishers, Inc. 1630 north Main Street, #367, Walnut Creek, CA 94596.

192. Prabhakar, V.N., R.S. Bisht, R.W. Law, J.M. Kenoyer (2012) Stone Drill Bits from Dholavira – A Multi-Faceted Analysis, Man and Environment XXXVII (1): 8-25

193. Pracchia, S., M. Tosi and M. Vidale, "On the Type, Distribution and Extent of Craft industries at Mohenjo-Daro" in "South Asian Archaeology 1983", edited by J. Schotsmans and M. Taddei, pp. 207 – 247, 1985

194. Quivron, G., "Incised and Painted marks on the Pottery of Mehrgarh and Nausharo – Baluchistan" in "South Asian Archaeology 1995" edited by Raymond and Bridget Allchin, pp. 45 – 62, Oxford and IBH Publications, New Delhi, 1997.

195. Raikes, R.L., (1967) The Mohenjo-daro Floods-Further Notes, Antiquity, 41: 64-66.

196. Raikes, R.L., Mohenjo-daro Environment, in Frontiers of the Indus Civilization, eds., Lal, B.B., and Gupta, S.P., 455-460.

197. Ramachandran, K. S. (1991). Madinat Hamad: burial mounds-1984-85. Bahrain National Museum, Ministry of Information, State of Bahrain Sarasvati,S.S.P. and Usha Jyotiismati. (1979).The Śulba Sutras: text on the Vedic geometry. Dr. Ratn Kumari Svadhyaya Sansthana, Allahabad.

198. Rao, S.R. (1979), Lothal: A Harappan Port Town, 1955-62, Memoirs of the Archaeological Survey of India 78, Vol. I

199. Rao, S.R. (1985), Lothal: A Harappan Port Town, 1955-62, Memoirs of the Archaeological Survey of India 78, Vol. II

200. Ratnagar, S. (1981), Encounters, the Westerly Trade of the Harappa Civilization, Oxford University Press, Delhi.

201. Ratnagar, S., "Harappan Trade in its 'World' context" in "Man and Environment", No. 19 (1–2), pp. 115 – 127, 1994

202. Reade, J. (2001), Assyrian King-Lists, the Royal Tombs of Ur, and the Indus Origins, Journal of Near Eastern Studies 60 (2001), pp. 1-29.

203. Reade, Julian 2003. The Royal tombs of Ur. In Art of the first cities; the third millennium B.C. from the Mediterranean to the Indus, ed. Joan Aruz, the Metropolian Museum of Art, Yale university Press, New Haven and London 93-96.

204. Redding, R. W. 1984. Theoretical determinants of a herder's decisions: modeling variation in the sheep/goat ratio, pp. 223-241 in Animals and Archaeology: 3. Early Herders and their Flocks, J. Clutton- Brock and C. Grigson, eds., BAR Intemational Series 202, British Archaeological Reports, Oxford.

205. Roy, B. and S.S. Merh, 1977, Geomorphology of the Rann of Kutch and Climatic Changes. Ecology and Archaeology of Western India. D.P. Agrawal and B.M. Pande, eds. pp. 195-200 Delhi : Concept Publishing.

206. Saar, S.S. (1991). Madinat Hamad: burial mounds-1984-85. Bahrain National Museum, Ministry of Information, State of Bahrain Sharma, D.V., K.C. Nautiyal and V.N. Prabhakar. (2006). Excavations at Sanauli 2005-2006: a Harappan necropolis in the Upper Ganga-Yamuna Doab. Purātattva 36: 166-179.

207. Saar, S.S. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain Sharma, D.V., K.C. Nautiyal and V.N. Prabhakar. (2006). Excavations at Sanauli 2005-2006: a Harappan necropolis in the Upper Ganga-Yamuna Doab. *Purātattva* 36: 166-179.

208. Sali, S. A. (1986). *Daimabad: 1976-79*. Archaeological Survey of India, Govt. of India, New Delhi.

209. Sali, S. A. (1991). Madinat Hamad: burial mounds-1984-85. Bahrain National Museum, Ministry of Information, State of Bahrain.

210. Sali, S. A. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain.

211. Sali, S.A., (1986) Daimabad, 1976-79, Memoirs of the Archaeological Survey of India, 83.

212. Sankhyan, A.K., and Weber, G.H.J., (2001) Evidence of Surgery in Ancient India: Trepanation at Burzahom (Kashmir) over 4000 years ago, International Journal of Osteoarchaeology 11: 375-380

213. Saraswat, K.S., (1993) Plant Economy of Late Harappans at Hulas, Puratattva, 23: 1-12.

214. Sayce, A.H. (1924), Remarkable Discoveries in India, Illustrated London News, 27 September, p. 566.

215. Schoff, Wilfred H. 1974 (2nd ed.) The Periplus of the Erythraean Sea: Travel and trade in the Indian Ocean by a merchant of the first century, Oriental Book Reprint Corporation, 54, Rani Jhansi Road, New Delhi-

110055.

216. Settar, K., and Korisettar, R., (2002) Introduction to the Indian Archaeology in Retrospect (Volume II): Protohistory: Archaeology of the Harappan Civilization, eds., Settar and Korisettar, ICHR

217. Shaffer, J.G. and B.K. Thapar, "Pre-Indus and Early Indus Cultures of Pakistan and India", in "History of Civilization of Central Asia" edited by A.H. Dani and V.H. Masson, Vol. I, pp. 247 – 281, UNESCO Publishing, Paris, 1996.

218. Shaffer, J.G., "The Indo-Aryan Invasions: Cultural myth and Archaeological Reality" in "The People of South Asia" edited by J.R. Lukas, Plenum Press, New York, 1984

219. Sharma, A.K. (1982) The Harappan Cemetery at Kalibangan: A Study, in Harappan Civilization: A Contemporary Perspective, ed., Possehl, G.L., 297-291.

220. Sharma, Y.D. (1956) *Past Pattern in Living as unfolded by the Excavations at Rupar.* Lalit Kala, no.2: pp. 121-29.

221. Sharma, Y.D., (1982) The Pre-Harappans in Punjab, Puratattva, 11: 34-38.

222. Sharma, Y.D., (1987) Fresh Light on the Bara Culture from Mahorana, in Archaeology and History: Essays in Memory of Sh. A. Ghosh, eds., Pande, B.M., and Chattopadhyaya, B.D., 157-176.

223. Sharma, Y.D., (1989) Ropar, An Encyclopaedia of Indian Archaeology, ed., Ghosh, A., 377-381.

224. Shinde, V., (1992) Excavations at Padri-1990-91: A Preliminary Report, Man and Environment, 17(1): 79-86.

225. Shinde, V., and Kar, S.B., (1992) Padri Ware: A New Painted Ceramic found in Harappa Levels at Padri in Gujarat, Man and Environment, 17(2): 105-110.

226. Shinde, V.S, T. Osada, A. Uesugi and M.M. Kumar (2008). A report on excavations at Farmana 2007-08. T. Osada and A. Uesugi (eds.) *Occasional Paper 6: Linguistics, Archaeology and the Human Past*. Indus Project, Kyoto: pp. 64-78.

227. Singh, Gurdip., 1971, The Indus Valley Culture. Archaeology and Physical Anthropology in Oceania 6(2) : 177-189.

228. Sinha, A.K. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain.

229. Sonawane, V.H., (2002) Post-Urban Harappan Culture in Gujarat, in Indian Archaeology in Retrospect (Volume II): Protohistory: Archaeology of the Harappan Civilization, eds., Settar and Korisettar, ICHR, 159-171.

230. Sonawane, V.H., and Ajithprasad, P., (1994) Harappa Culture and

Gujarat, Man and Environment, 19(1-2): 129-130.

231. Sonawane, V.H., and Mehta, R.N., (1985) Vagad-A Rural Harappan Settlement in Gujarat, Man and Environment, 9: 38-44.

232. Soundara Rajan, K.V, 1984, Kutch Harappan – A Corridor of the Indus Phase. Frontiers of the Indus Civilization. B.B. Lal and S.P. Gupta, eds. pp. 217-226. New Delhi. Books and Books.

233. Srivastava, K.M. (1991). *Madinat Hamad: burial mounds-1984-85*. Bahrain National Museum, Ministry of Information, State of Bahrain.

234. Srivastava, K.M. (1991). Madinat Hamad: burial mounds-1984-85. Bahrain National Museum, Ministry of Information, State of Bahrain.

235. Stein, A., (1929) An Archaeological Tour in Waziristan and Northern Baluchistan, Memoirs of the Archaeological Survey of India, 37.

236. Stein, A., (1930) An Archaeological Tour in Upper Swat and Adjacent Hill Tracts, Memoirs of the Archaeological Survey of India, 42.

237. Stein, A., (1931) an Archaeological Tour in Gedrosia, Memoirs of the Archaeological Survey of India, 43.

238. Thapar, B.K. (1975), Kalibangan: A Harappan Metropolis beyond the Indus Valley, Expedition 17(2): 19-32

239. Thapar, B.K., (1982)The Harappan Civilization: some Reflections on its Environments and Resources and their Exploitation, in Harappan Civilization: A Contemporary Perspective, eds., Possehl, G.L., Delhi, 3-13.

240. Thapar, B.K., (1985) "Recent Archaeological Discoveries in India" UNESCO Publicaiton, Paris.

241. Tosi, M. (1982), A Possible Harappan Seaport in Eastern Arabia: Ra's Al-Junayz in the Sultanate of Oman (manuscript), Paper presented in the First International Conference on Pakistan Archaeology, Peshawar, 1982.

242. Tosi, M., "The Harappan Civilization Beyond the Indian Subcontinent" in "Harappan Civilization: A Recent Perspective", edited by G.L. Possehl, pp. 365 – 378, Oxford and IBH Publications, New Delhi, 1993.

243. Tosi, M., (1969) Excavations at Shahr-i-Sokhta, Preliminary Report on the Second Campaign, September – December, 1968, East and West, 19(3-4): 283-386.

244. Vats, M.S. (1940).*Excavations at Harappa*. 2 vols. Delhi: Government of India.

245. Vidale, M., "Specialized Producers and Urban Elites: On the Role of Craft Industries in Mature Harappan Urban Contexts", in "Old Problems and New Perspectives in the Archaeology of South Asia" edited by J.M. Kenoyer, pp. 171 – 181, Wisconsin Archaeological Report 2, University

of Wisconsin, Madison, 1989

246. Vidale, M., (1995) Early Beadmakers of the Indus Tradition: The Manufacturing Sequence of the Talc Beads at Mehrgarh in the 5th Millennium B.C., East and West, Vol. 45

247. Vogt, Burkhardt 1994. In Search for coastal sites in pre-historic Makkan : Mid Holocene "shell-eaters'' in the coastal desert of Ras al- Khaimah, U.A.E. In From Sumer to Meluhha: Contributions to the archaeology of south and west Asia, In memory George F.Dales, Jr., ed. Jonathan Mark Kenoyer, Wisconsin Archaeological Reports, Vol.3, Department of Archaeology, University of Wisconsin, 113-28.

248. Weisgerber, G., (1984) Makan and Meluhha – Third Millennium BC Copper Production in Oman and the Evidence of Contact with the Indus Valley, South Asian Archaeology, 1981: 196-201.

249. Weisgerber, Gerd, 2007, "Copper from Magan for Mesopotamia cities". In In the shadow of the ancestors: The prehistoric foundations of the early Arabian Civilization in Oman. Ministry of Heritage and culture, Sultanate of Oman, 195-96.

250. Wheeler, R.E.M. (1947). Harappa 1946: the Defences and Cemetery R-37, *Ancient India*, vol. 3: pp. 58-130.

251. Wheeler, R.E.M., (1946) India's Earliest Civilization: Recent Excavations in the Indus Basin, Illustrated London News, August 19: 158-159.

252. Wheeler, R.E.M., (1947) Archaeology in Afghanistan, Antiquity, 21: 57-65.

253. Wheeler, R.E.M., (1947) Harappa 1946: The Defenses and Cemetery R-37, Ancient India, 3: 58-130.

254. Wheeler, R.E.M., (1968) "The Indus Civilization", 3rd Edition, Cambridge University Press, Cambridge.

255. Wilson, H.H. (reprint 1974, 77, 78). Ṛg-veda Saṁhitā. (English translation). Vols. I-V. Nag Publishers, 8-A/U.A-3, Jawahar Nagar, Delhi-110007.

256. Wilson, H.H. (*reprint* 1974, 77, 78). *Ṛg-veda Saṁhitā*. (English translation). Vols. I-V. Nag Publishers, 8-A/U.A-3, Jawahar Nagar, Delhi-110007.

257. Wright, R.P., (1989) New Perspectives on Third Millennium Painted Grey Wares, South Asian Archaeology 1985: 137-149.

258. Xu Chaolong, (1990) The Kot Dijians and the Harappans: Their Simultaneity – another possible interpretation, South Asian Archaeology 1987, 157-201.

259. Zarins, Juris 1989. Eastern Saudi Arabia and external relations: Selected ceramic, steatite, and textual evidence : 3500-1900 B.C. In South Asian Archaeology 1985, ed. Karen Frifelt and Per Sorensen,

Nordic Institute of Asian Studies, Occasional papers 4, London/Riverdale, 74-103.